SCIENCE ABSTRACTS.

Section A.—PHYSICS.

OCTOBER, 1926.

GENERAL PHYSICS.

2237. *Extension and Compressibility Coefficients in Liquids.* **V. S. Vrkljan.** (Zeits. f. Physik, 37. 6. pp. 458–468, 1926.)—The theoretical relation between these two coefficients is worked out, and the result is tested by means of Amagat's experimental data. The two are in harmony.
A. D.

2238. *Slow Transformations of Solids.* **B. Weinberg.** (Indian Assoc. for Cultivation of Science, Proc. 9. pp. 215–250, June, 1926.)—This paper is a part summary of fifty-two previous publications, the bibliography of which is included, and is devoted to methodology, attempting to answer what problems can be set before an investigator of transformations of a solid body subjected to forces exceeding its limit of elasticity and in what form the results may be represented. The author discusses the kind of deformations from which the most fruitful results may be expected, concluding that preferably such kinds of deformation should be chosen where only change of form is involved. A list of such cases is given. Complementary conditions are illustrated by an example of the deformation of unilateral extension accompanied by the transversal contraction, Kirillov's work being quoted. The article concludes with a brief account of the great influence of temperature on the slow deformations of solids. The paper should be consulted in its entirety, being a useful guide to the separate publications.
H. H. Ho.

2239. *Plasticity of Metals.* **H. Shōji and Y. Mashiyama.** (Inst. Phys. and Chem. Research, Tôkyô, Sci. Papers, No. 57–58. pp. 189–205, April, 1926. In English.)—The first author gives a new definition of plasticity which differs from previous definitions by being quantitative. Plasticity is thus defined by the equation $P = 1/w_0 \, dv/dw$, where v is the velocity of elongation per unit length, w_0 the intensity of stress corresponding to the elastic limit when $v = 0$, and w the intensity of the applied stress diminished by w_0. The order of plasticity of common metals at room-temperature is found to be Cd, Pb, Sn, Au, Zn, Ag, Al, Cu. The plasticity of ductile metals is found to decrease more rapidly with the period of strain, as compared with other metals. The joint authors have determined the plasticity of Pb, Sn and Cd at temperatures higher than atmospheric. They find that the plasticity increases very rapidly with the rise of temperature, and becomes very large at their melting-points. The elastic limit or the yielding point of metals decreases with rise of temperature and becomes zero at their melting-points. Even though the plasticity or the elastic limit of a metal is greater than that of another metal at room-temperature, it is not always so at another temperature, *e.g.* Pb and Sn. C. O. B.

2240. *The Rotating Millstone.* **L. Lecornu.** (Comptes Rendus, 182. pp. 1253–1255, May 25, 1926.)—The problem of the elasticity equilibrium of a rotating millstone subjected to centrifugal force is extremely difficult, but the author has shown previously (*loc. cit.* **123**, 1896, p. 96) that an approximate solution may be obtained by replacing the rectilinear generator of the cylindrical contour by an elliptic arc. This solution is based on the fact that if an ellipsoid of revolution is turned about its axis so that the square of the ratio between the equatorial and polar diameters may be $4\lambda(3\lambda + 2\mu)/(\lambda + 2\mu)(7\lambda + 6\mu)$, where λ and μ are Lamé's coefficients, then the plane sections perpendicular to the axis are not subjected to any tension, *i.e.* that the section comprised between any two parallels, and especially when symmetrically situated about the equator, is in a state of elastic equilibrium. The previous investigation dealt with a plane millstone, and the present paper takes account of the additional modifications required in an industrial machine for the central orifice through which the spindle passes. The paper is entirely mathematical, and concludes with a discussion of the rupture limit. H. H. Ho.

2241. *Tension Conditions at the Flow Limits (Plasticity Condition).* **F. Schleicher.** (Zeits. Math. u. Mechanik, 6. pp. 199–216, June, 1926.)—A critical survey is given of the hypotheses previously proposed for the flow state, and these are shown for the most part not to be in accord with actual conditions. Consequently the author submits a new hypothesis which is in better agreement with the latest data of v. Kármán, Böker and Lode than that of Mohr, while supplying an explanation in cases where the latter is invalid. Advantages are also claimed over Beltrami's proposals for the elastic energy limits and especially for the difficulties which arise with building materials having different limiting flow tensions. The paper is replete with data and diagrams, and should be consulted in its entirety. H. H. Ho.

2242. *Precession of a Projectile.* **F. Burzio.** (Accad. Lincei, Atti, 3. pp. 599–603, May 18, 1926.)—A mathematical paper. It is proved that at the origin of the trajectory the velocity of precession is half that of a "top." The velocity of nutation is equal to the rate of change of direction of the trajectory in a vertical plane. Ultimately the precession becomes equivalent to that of a "top" and the nutation zero. A. Wh.

2243. *Speed of Propagation of the Solitary Wave.* **A. Weinstein.** (Accad. Lincei, Atti, 3. pp. 463–468, April 18, 1926.)—The solitary wave, first observed by Scott Russell, consists of a single elevation travelling without change of form at a constant speed c in a channel of finite depth h, the real motion of the particles (of low speed relatively to c) proceeding in vertical planes. The speed c is intimately connected with the maximum elevation a above the mean level by the remarkable ratio $c^2 = g(h + a)$. The author studies the problem by the method of Levi Civita, "Rigorous Determination of Permanent Waves," *Mathematische Annalen*, 93 (1925), and in the course of a mathematical discussion establishes a ratio which is an approximation of a higher order than the preceding. E. F.

2244. A *Particular Class of Solutions of the Problem of the Circular Ring. Application to the Theory of Thick Circular Arches.* **R. Chambaud.** (Comptes Rendus, 182. pp. 1382–1384, June 7, 1926.)—A theoretical mode of determination of stresses and strains in a circular ring utilising the method employed in the theory of Ribière (*ibid.*, 1889, 108, 561; 1901, 132, 315) is developed and applied to the case of a thick circular arch. A number of corrections are made in a second note [Errata (*ibid.*, p. 98, July 5, 1926)]. J. S. G. T.

2245. *Contribution to the Study of the Plane Motion of Fluids.* **A. Toussaint** and **E. Carafoli.** (Comptes Rendus, 182. pp. 1268–1270, May 25, 1926.)—The obstacle—a wing section, an illustration of which is given in the original—is placed in a narrow channel, 1 cm. by 26·5 cm., with glass sides. A current flows along the channel, and the stream-lines are made visible by means of coloured liquid. W. G. B.

2246. *Drag of an Aerofoil for Two-Dimensional Flow.* **A. Fage** and **L. J. Jones.** (Roy. Soc., Proc. 111. pp. 592–603, July 2, 1926.)—Bryant and Williams have shown that the flow around the central part of an aerofoil, at a sufficient distance from the walls, is approximately two-dimensional, and G. I. Taylor has shown that the drag can probably be determined with good accuracy from observations of total-head losses in the wake, provided these are measured at a sufficient distance behind the aerofoil [see Abstract 439 (1926)]. The authors have established this fact by direct measurement in the case of an aerofoil of 0·5 ft. chord mounted in a 4-ft. tunnel with small clearances between the tips and the tunnel walls. J. W. T. W.

2247. *Periodic System, Chemical Bonds, and Crystal Structure.* **A. Sommerfeld.** (Nature, 117. pp. 793–795, June 5, 1926.)—This article is based on a lecture of the series delivered at the Royal College of Science in March, 1926. The following points are discussed: (1) The bearing of Stoner and Main Smith's modification of Bohr's scheme for the Periodic Table on the X-ray spectra; (2) two laws showing how the inner quantum numbers of the completed atoms in the unexcited state indicate when a sub-group of the table is completed; and (3) the basic principle of chemical combination as a tendency to form completed sub-groups. The occurrence of the two-shell or helium type as a stable form next in importance to the eight-shell of the inert gases is emphasised. It is suggested that certain compounds show that there is a tendency to form four-shells, and crystallographic evidence is advanced in support. The tetrahedral structures found for diamond and carborundum are also observed in binary compounds of elements drawn one from either side of Column IV of the Periodic Table and removed an equal number of columns from Column IV. It is presumed that the mechanism of binding in these compounds will be the same as in the diamond, and in particular that it will be non-polar. X-ray intensity measurements on zinc sulphide by H. Ott indicate that probably the zinc and sulphur occur in the crystal as neutral atoms. W. S. S.

2248. ***The Relation to Physics of the Notion of Convergence of Series.*** **H. Jeffreys.** (Phil. Mag. 2. pp. 241–244, July, 1926.)—It is well known that an infinite series may be useful in physical applications without being convergent in the sense defined in works on pure mathematics, although it is less generally realised that the converse is equally true, *viz.* a series may be convergent and yet be totally useless for the purpose of calculating the value of the function represented. Convergence and utility are essentially unconnected, and for the latter purpose in physics one is limited to expansions that can be summed numerically in the time available, *i.e.* where the first few terms give a good approximation to the function. The definition of an asymptotic approximation is nearer to the physicist's needs than is that of convergence. The question has arisen in connection with an approximate solution by Stoneley of the problem of the straining of the earth by bodily forces, that a finite number of terms may be a good approximation to a function without being also a set of terms from a series of terms of the same form that represents the function exactly, and this question is now discussed at length, the fundamental hypothesis of Stoneley's method being thereby justified.

H. H. Ho.

2249. ***Alkali Perchlorates, etc.*** **A. E. H. Tutton.** (Roy. Soc., Proc. 111. pp. 462–491, July 2, 1926.)—Investigates the optical properties of the perchlorates of K, Rb, Co and NH_4; the results for the metallic salts show a regular progression according to atomic numbers, similar to that observed with the sulphates. The refractive indices are almost identical. The molecular refraction of NH_4ClO_4 is nearly the same as that of $RbClO_4$. It is shown that in a well-established isomorphous series, if one member be worked out thoroughly by X-ray analysis, so that the space-lattice, unit-cell dimensions and character are fixed with certitude, then the absolute cell-dimensions of all the other members of the series can be obtained by calculation from the topic axial ratios. In this case the barytes group of minerals, the perchlorates and the permanganates of the alkalis form such a series, and the structure of barytes has been thoroughly worked out by X-ray methods. The author has calculated the absolute cell-dimensions of the alkali perchlorates from the barytes values. The values thus obtained in the case of $KClO_4$ agree with those deduced from X-ray measurements by James and Wood. H. N. A.

2250. ***The Structure of Beryl,*** $Be_3Al_2Si_6O_{18}$. **W. L. Bragg** and **J. West.** (Roy. Soc., Proc. 111. pp. 691–714, July 2, 1926.)—The structure of beryl, described in this paper, has some interesting features detailed. The ratio of silicon to oxygen atoms in the molecule is that of a metasilicate, no other example of which has yet been completely analysed. Although the ratio of Si to O is 1 : 3, no SiO_3 groups have been found, but instead an arrangement of oxygen atoms around a silicon atom of exactly the same conformation as the groups SiO_4 in typical orthosilicates such as olivine and garnet. In this metasilicate the ratio of one Si to three O's is effected by a sharing of two O atoms of each tetrahedral SiO_4 group with neighbouring groups, and the structure forms an intermediate stage between the orthosilicates and the structures of quartz and christobalite [see Abstract 454 (1926)], where every O is shared by Si atoms. The structure has been analysed by quantitative measurements of the absolute intensity of X-ray reflection, interpreted by the formulæ which are valid for simpler cases, and found to depend on seven parameters which are claimed to be directly and accurately fixed. A Fourier analysis of electron distribution concludes the paper, which is replete with data and diagrams. **H. H. Ho.**

2251. *The Crystalline Structure of Anhydrite.* **E. C. S. Dickson** and **W. Binks.** (Phil. Mag. 2. pp. 114–128, July, 1926.)—Natural crystals of anhydrite, $CaSO_4$, were examined by the ionisation spectrometer method; intensities were compared directly or indirectly with a standard rock-salt reflection; the values obtained for the dimensions of the unit cell agree with those published by Rinne, Hentschel and Schiebold during the investigation fairly well. The cell contains four molecules, and the space group seems to be that found by R, H and S, namely, V_h^{17}. Intensity considerations show that the structure suggested by Rinne is incorrect, and an investigation of the possibilities based on the assumption that the SO_4 group has its oxygens at the corners of a regular tetrahedron leads to a structure which gives pretty good agreement when all the spectra observed are considered. Each atom is immediately surrounded by eight O atoms, four at 2·55 Å., two at 2·43 Å. and two at 2·47 Å.; the smallest distance between Ca atom centres is 3·68 Å., and that between S and O atom centres is 1·50 Å. A figure in the original paper shows the relative positions of the Ca and O atoms in the model; these are also shown in two diagrams. **H. N. A.**

2252. *Studies on the Deformation of Tungsten Single Crystals.* **F. S. Goucher.** (Phil. Mag. 2. pp. 289–309, July, 1926.)—This is a continuation of previous work [see Abstract 20 (1925)], Pintsch single crystal wires being used in addition to the recrystallised hard-drawn tungsten wires previously used. Measurements of rate of flow under constant load were made at both 2000° K and 1000° K, which show internal hardening increasing rapidly at first and then proportional to increase of stress. The hardening is greater at the lower temperature, and may be removed by heating to 2500° K for two minutes. An X-ray study reveals crystallographic distortions which are not apparently altered by annealing. No measurable difference of resolving power was found in the hard and annealed states, while Pintsch wires show impaired resolution which improves with annealing. Microscopic examination confirms the persistence of crystal distortion, but exhibits a profound difference in the etching effect. The experiments support the view that hardening is due to residual elastic strains produced by the deformation process rather than the mere fact of crystal break-up. **F. S.**

2253. *The Imperfect Crystallisation of Common Things.* **W. Bragg.** (Nature, 118. pp. 120–122, July 24, 1926. Abstract of abbreviated lectures delivered at the Royal Inst., April and May, 1926.)—The lectures contained an account of the methods used and the results obtained by the crystallographic examination of a number of organic substances such as ramie fibre, cotton-wool, mercerised cellulose, artificial and natural silks, chitin from snails and insects, the spines of the sea-urchin, also of rolled and drawn metals. In all the above cases there is a tendency, more or less marked, to orientation of the crystals. H. N. A.

2254. *Molecular Weights by Radiograms.* **R. O. Herzog.** (Phys. Zeits. 27. pp. 378–379, June 1, 1926.)—Comments on Ott [Abstract 1248 (1926)]. The calculations of Ott are based upon the assumption that the maximum measured distance between lattice planes indicates an identity period, and that the first observed reflection is to be ascribed to (100), (010) or (001). That assumption was by no means always justified; thus in the case of aluminium Ott's method would yield the unit cell volume 12·8, whilst the actual volume was 67·5. Ott tested his method by observations of the amyloses (di-, tetra-, octo-), the lattice structure of which was unknown, and his method might give too large and too small values for the upper limits. His calculations of cellulose fibres also lead to doubtful values, and his method admits, in the author's opinion, only of estimates of the order of magnitude. H. B.

2255. *A Comparison of the Atomic Weights of Silicon from Different Sources.* **P. L. Robinson** and **H. C. Smith.** (Chem. Soc., J. pp. 1262–1282, June, 1926.)—The authors have determined the densities of specimens of silicon tetrachloride prepared by them from ferrosilicon prepared from local materials in Sweden, France, the United States and Canada, and of one prepared from pegmatite obtained in Scotland. The method of purification is described, and was the same for each of the specimens; it included a number of fractional distillations, the last of which were conducted in a vacuum. The densities were determined by means of glass floats, standardised in bromobenzene, the temperature at which each of the ten floats used remained balanced in the liquid being very accurately determined. The density of the bromobenzene was determined by the pyknometer method at four different temperatures. Two of these floats were used with each specimen of $SiCl_4$, thus obtaining its densities at two different temperatures, and from these the density at 20° C. was calculated. The mean density for all the specimens was 1·481245, with an extreme variation of 0·000050. The coefficients of thermal expansion were also calculated and agreed closely together. It is concluded that no greater variation than 0·005 unit in the atomic weight is to be expected in the samples under consideration. H. N. A.

2256. *The Element of Atomic Number* 61; *Illinium.* **J. A. Harris, L. F. Yntema** and **B. S. Hopkins.** (Nature, 117. pp. 792–793, June 5, 1926.)—Very pure neodymium, atomic number $Z = 60$, and samarium, $Z = 62$, were prepared from monazite sands, and it was found that in the infra-red arc spectra there were a number of identical lines, which might be due to a small amount of a new element. It did not seem possible to separate an element $Z = 61$ by fractional crystallisation of the double magnesium nitrate, and advantage was taken of the fact that the order of solubility of the bromates of the cerium group earths is the reverse of that of the soluble nitrates, which makes it probably easier to separate the suspected new element from neodymium by converting into bromate. After repeated recrystallisation two bands in the absorption spectrum, which were very faint in the original neodymium, became stronger, while other bands disappeared. If these bands are ascribed to Z = 61 they take their places in a more or less regular sequence shown by bands of neighbouring elements; this was confirmed by X-ray analysis, $\lambda = 2 \cdot 2781$ Å. for the $L\alpha_1$ line and $2 \cdot 0770$ for $L\beta_1$. H. N. A.

2257. *Atomic Structure and the Magnetic Properties of Coordination Compounds.* **L. C. Jackson.** (Phil. Mag. 2. pp. 86–96, July, 1926.)—Shows that Welo and Baudisch's treatment of the paramagnetic coordinations compounds is not particularly successful; a satisfactory account of the magnetic properties of atoms cannot be given without considering the distribution of the electrons among the sub-groups of the different levels. The scheme proposed by Bose is also discussed, and it is shown that that of Cabrera agrees with the known magnetic properties of the simple salts of Cr^{+++}, Fe^{+++}, Mn^{++}, Co^{+++}, Fe^{++}, Co^{++}, Ni^{++}, Cu^{++}; there is also agreement for the sixfold coordination compounds of Cr^{+++} and Ni^{++}, the coordination compounds of Co^{+++} and Fe^{++} and in other cases. It is not very satisfactory for the fourfold Ni compounds. The author suggests that it is possible that the tendency of the M_{32} sub-group, to be completed, as suggested by Cabrera, may not really exist, and gives reasons; this may explain the properties of the fourfold compounds, the distribution of the electrons in the M_{32} and M_{33} sub-groups being the same in the coordination compounds and the simple salts. H. N. A.

2258. *Atomic Mechanics.* **L. Brillouin.** (J. de Physique et le Radium, 7. pp. 135–160, May, 1926.)—A summary and presentation of the essentials of recent mathematical investigations of atomic mechanics. The authors chiefly followed are Heisenberg, Born, Dirac and Kramers. A. Wh.

2259. *Characteristic Frequencies of Diatomic Molecules in Undulatory Mechanics.* **E. Fues.** (Ann. d. Physik, 80. 4. pp. 367–396, June 22, 1926.)—The author applies the methods of Schrödinger's undulatory mechanics to determine the frequencies of a diatomic molecule in both oscillation and rotation. He finds that the new theory indicates that (1) a continuous spectrum will be produced, and (2) the "oscillation quantum numbers" as well as the "rotation quantum numbers" will take half-integral values. A detailed discussion is then given of the method of dealing with small perturbations on the new theory. This treatment is applied to the problem under consideration, and leads to the complete formula of Kratzer for the band-spectra of diatomic molecules except that where Kratzer has integral quantum numbers, here half-quantum numbers occur. The paper is mathematical. W. S. S.

2260. *Diatomic Molecules.* **F. J. v. Wiśniewski.** (Zeits. f. Physik, 37. 1–2. pp. 126–136, 1926.)—An empirical expression for the dielectric constant of HCl, HBr, CO, N_2 is tested. Shown that Bohr's diatomic model suits the above compounds. The generally accepted theory of dielectrics is not able with Bohr's model to reach the given empirical expression. A. D.

2261. *Multiply Periodic Systems in Quantum Mechanics.* **G. Wentzel.** (Zeits. f. Physik, 37. 1–2. pp. 80–94, 1926.)—The new quantum mechanics, unlike the old, has not yet led to a general method for determining the frequencies of the spectral lines, independently of their intensities. In this mathematical paper the author investigates such a general method. Dirac [see Abstract 1245 (1926)] has shown that for restricted periodic systems the determination of the frequencies can be made to depend on the introduction of a system of uniformising variables which correspond to the action and angle variables, I and w, in the earlier theory. In order to obtain this system of uniformising variables, the author defines an action function S and identifies the I's with the moduli of periodicity of this function. The treatment is analogous to the classical theory of action and angle variables. The method is applied to the linear oscillator and the hydrogen atom, with and without relativity correction. The Sommerfeld result for the fine structure of the Balmer series is confirmed. W. S. S.

2262. *Drag on the Ether.* **H. Mineur.** (Comptes Rendus, 182. pp. 1275–1276, May 25, 1926.)—Concludes that if we wish to explain Michelson's experiment by the hypothesis of a partial drag on the ether by the earth we must admit that the density of the ether varies at least in the ratio of 5 to 1 when we pass from the terrestrial surface to a region where the drag is zero, which is very improbable. A. D.

2263. *Miller's Ether Drift Experiment.* **O. Lodge.** (Nature, 117. p. 854, June 19, 1926.)—Miller's work on ether drift is briefly referred to and its significance discussed. The results obtained establish the accepted fact that the motion of the earth in its orbit fails to give any but a minute residual and doubtful ether drift effect. Whether the results indicate a drift of the solar system in a direction approximately normal to the plane of the ecliptic, as suggested by Miller, remains to be discussed [see Abstracts 2438 (1925) and 2025 (1926)]. J. S. G. T.

2264. *Ether Drift Experiments.* **D. C. Miller.** (Nature, 117. p. 890, June 26, 1926.)—Miller supplements the remarks and replies to the queries of O. Lodge [see preceding Abstract]. It is contended that the observed effects are not attributable to disturbances. The reported effect is present in every single observation; it is not related to the instrument or its surroundings, and is shown to be directly related to a cosmical cause. The result is entirely consistent with the observations of Michelson and Morley (1887) and with those of Morley and Miller (1902–1906). J. S. G. T.

2265. *Miller's Ether Drift Experiments.* **H. Thirring.** (Nature, 118. pp. 81–82, July 17, 1926.)—The author considers that Miller's observed displacements of the fringes in his ether drift experiments are not attributable to any cosmic cause, and that the assumption, on the basis of the results, of the existence of an ether drift of constant direction towards a certain point of the heavens is unjustifiable. The observed displacements may be due to local disturbances [see Abstracts 2438 (1925) and 2025 (1926) and the two preceding Abstracts]. J. S. G. T.

2266. *Waves of Discontinuity of the Second Order in an Einsteinian World.* **H. Mineur.** (Comptes Rendus, 183. pp. 182–183, July 19, 1926.)—It is shown that in an Einsteinian universe an absolute discontinuity is propagated with the velocity of light. In a universe possessing spherical symmetry, a wave of the second order conserving the symmetry of the universe is not propagated. Thus the only form of ds^2 compatible with spherical symmetry in which the g_{ik}'s depend upon t is that derived by Schwarzschild; outside a pulsating sphere ds^2 has the same form as if the sphere were at rest. J. S. G. T.

2267. *Application of [the Theory of] Relativity to Atomic and Molecular Systems.* **T. de Donder.** (Comptes Rendus, 182. pp. 1380–1382, June 7, 1926.)—The relativistic-statistical theory of atomic and molecular systems is very briefly discussed. The quantification of such systems depends upon the introduction into the canonical equations of a parameter derived from optical or spectral theory. J. S. G. T.

2268. *Quantification based upon Einstein's Theory of Gravity.* **T. de Donder** and **F. H. van den Dungen.** (Comptes Rendus, 183. pp. 22–24, July 5, 1926.)—A possible mode of quantification of atomic and molecular systems discussed by de Donder [see preceding Abstract] based upon Einstein's gravitational theory is developed. J. S. G. T.

2269. *Determination of the Potentials in the General Theory of Relativity, with some Remarks about the Measurement of Lengths and Intervals of Time and about the Theories of Weyl and Eddington.* **H. A. Lorentz.** (K. Akad. Amsterdam, Proc. 29. 3. pp. 383–399, 1926.)—A possible mode of deduction of the potentials in a gravitational field, from observations of the course of rays of light and the motion of material particles, as postulated in the theory due to Kretschmann [see Abstract 457 (1918)], is detailed. If in a diagram in a four-dimensional space R_4 each projectile is numbered and is represented by its world-line, and if on this diagram values of coordinates and potentials be inscribed, then definite values, independent of the choice of coordinates, can be assigned to lengths of lines and to intervals of time. It is shown that the components of a vector will have changed when the vector has been carried round a closed path, and equations for the changes are derived. All quantities involved in the phenomena of gravitation and electromagnetism can be derived from certain "fundamental numbers," Γ^c_{ab}, which are such that $\Gamma^c_{ab} = \Gamma^c_{ba}$. The variety of these numbers is considerably greater than that of the quantities to be deduced from them. Their introduction can be justified only if there be grounds for thinking that something hitherto unobserved lies behind their wide diversity. J. S. G. T.

2270. *The Quantum Hypothesis.* **G. Polvani.** (Elettrotecnica, 13. pp. 418–423, July 5, 1926.)—A recapitulation of the black-body radiation problem on classical theory and the introduction of the hypothesis of quanta. A bibliography of the most important contributions is given. Other aspects of the quantum theory are mentioned only. A. Wh.

METEOROLOGY AND GEO-PHYSICS.

2271. *The Velocity Equivalents of the Beaufort Scale.* **G. C. Simpson.** (Meteorological Office, Prof. Notes, No. 44 [24 pp.], 1926.

2272. *Diffusion over Distances ranging from 3 km. to 86 km.* **L. F. Richardson** and **D. Proctor.** (Roy. Meteorolog. Soc., Mem. 1. 1.

pp. 1–16, 1926.)—The atmospheric diffusion has been obtained from the travel of small balloons and from the travel of volcanic ash after an eruption of Asama in 1920. The resulting values of the diffusivity vary from 2×10^6 to $1 \cdot 3 \times 10^9$ cm.^{2}/sec.; this range includes the results previously found for manned balloons, and lies between the values found from the variation of wind with height and that obtained by Defant by treating cyclones as turbulence in the general circulation of their latitude. It is shown that ϵ (defined in this particular case so that $\epsilon = K/0 \cdot 330\sigma^{4/3}$, K being the diffusivity and σ the standard deviation) increases with increasing mean speed, and the relation between ϵ and speed is shown graphically for speeds below 38 m./sec.; ϵ is found to be roughly proportional to $\sigma^{1/3}$, making K proportional to $\sigma^{5/3}$ in the neighbourhood of $\sigma = 30$ km. A. W. L.

2273. *The Single-Layer Problem in the Atmosphere and the Height-Integral of Pressure.* **L. F. Richardson** and **R. E. Munday.** (Roy. Meteorolog. Soc., Mem. 1. 2. pp. 17–34, 1926.)—Treating the atmosphere as a single dynamical layer, statements are obtained for the height-integral of pressure in terms of latitude, longitude, time, pressure at the base-level and the two horizontal components of momentum of a column, but the observations do not confirm, at present, the hope that the atmosphere could be treated as a single dynamical layer. The height-integral of pressure P_t has been computed from the published records of registering balloons, the termini used being 500 m. above mean sea-level and a height so great that the air above it is negligible. The value of P_t found from the mean distribution is $7 \cdot 1 \times 10^{11}$ dynes cm.$^{-1}$ at the equator and $6 \cdot 9 \times 10^{11}$ in latitude 50° N. When many ascents are considered at one place, the variations of P_t are correlated with those of p_t, and the name "temporal dynamic height" is given to the ratio dP_t/dp_t found from many observations at one place. For winter at Lindenberg this ratio gives a mean value of 12·4 km. and for Pyrton Hill 8·1 km. Comparison of two places at one time is used to find the ratio, J, of the difference of P_t to that of p_t, and this gives a mean value for J of 9·90 km., but there is a large scatter. The ratio is called the "spatial dynamic height." The unequal and inconstant values of these two dynamic heights show that Laplace's equations for free tidal oscillations in an ocean of uniform depth are a very bad description of ordinary disturbances of the European atmosphere. R. S. R.

2274. *The Six-Hourly Variations of Pressure and Temperature.* **S. K. Pramanik.** (Roy. Meteorolog. Soc., Mem. 1. 3. pp. 35–57, 1926.)—The paper consists of a compilation of data relating to the six-hourly variations of atmospheric pressure and temperature similar to those which J. Hann has given for the twenty-four-hourly and eight-hourly variations of barometric pressure. Observational data have been used for 136 stations in the north and south hemispheres. Values of the fourth-order Fourier coefficients for the diurnal inequalities of atmospheric pressure and temperature are tabulated giving the mean annual amplitude a_4 with its components p_4 and q_4, and the phase A_4 for (1) stations lying along or near the coast or on islands, all these being of low altitude, and (2) stations on continents at a considerable distance from the sea and of high or low altitudes. The results are set out separately for summer and winter, and the figures for Indian, American and European stations have separate treatment.

It is concluded for the pressure variation that (1) the mean amplitude a_4 does not vary very much with latitude between $\pm 50°$, though it appears to have a maximum at about 25° latitude; it is nearly the same for inland as for coastal stations; (2) there is a considerable seasonal variation in a_4, the winter greatly exceeding the summer values, more particularly inland; (3) the annual mean phase A_4 is fairly constant from latitude 20° to about 50°, and decreases towards the equator; (4) the phase is irregular in summer but regular in winter; (5) the phase is considerably less over the ocean and oceanic islands than inland; (6) altitude affects amplitude and phase very little; and (7) considerable variations in amplitude and phase may occur at individual stations, especially in summer. For the temperature variations (1) the annual mean amplitude is a maximum at about 25° latitude, decreasing towards the equator and more rapidly farther north, while it is greater inland than on the coast; (2) winter values exceed summer values; (3) the annual mean phase is very regular, but varies little between $\pm 50°$ latitude, inland or on the coast; (4) there is a systematic seasonal variation of phase. R. S. R.

2275. *Meteorological Results of the Mount Everest Expedition.* **T. H. Somervell** and **F. J. W. Whipple.** (Roy. Meteorolog. Soc., J. 52. pp. 131–142; Disc., 142–143, April, 1926.)—The paper is divided into two parts, of which each author is responsible for one. In the first part details are given of the methods used to record temperature at the several camps reached, and in tabular form are stated (1) observations of wind, weather and temperature on the journey through Tibet and in the early stages at the base camp; (2) the weather diaries kept at the various camps reached during the ascent; (3) the temperature measurements at these camps; and (4) additional observations taken at the base camp. In the second part, by comparison of simultaneous measurements of temperature at 8, 12 and 16 h. at the several camps, values have been obtained of the average maximum and minimum lapse rates of temperature, and a comparison made with the mean temperatures obtained during this period in neighbouring parts of India. In the *Discussion* reference was made to the value of the observations in any future investigation of the meteorology of the upper air in India. R. S. R.

2276. *Observations of Wind, Wave and Swell on the North Atlantic Ocean.* **V. Cornish.** (Roy. Meteorolog. Soc., J. 52. pp. 145–157; Disc., 157–160, April, 1926.)—The author finds from numerous observations that, after a prolonged wind and with no swell, there is a close agreement between wind and velocity of waves. The observations are generally complicated by effects of swell, crossing swell causing a reduction in velocity of the waves, and concurrent swell giving rise to diminution in height and slight reduction in velocity. When two sets of swell cross the waves their respective effects in reduction of wave are strictly additive. A. W. L.

2277. *Determination of Minute Periodic Variations.* **J. Bartels.** (Roy. Meteorolog. Soc., J. 52. pp. 173–175; Disc., 176, April, 1926.)—The note has for its object to show, in the example of the lunar atmospheric tide at an extra-tropical station (Potsdam), that the ordinary procedure of taking means can be improved in some cases. The device already has been applied successfully to solar diurnal variations of pressure at

Antarctic stations, where the scarcity of material requires a delicate treatment. The scheme may be regarded as a development of the periodogram analysis introduced by Whittaker. Attention is drawn to the necessity that the grouping of the observations must be made according to a characteristic which is wholly independent of the quantity searched for. R. S. R.

2278. *Examination by Schuster's Periodogram of Rainfall Data from Long Records in Typical Sections of the World.* **D. Alter.** (Monthly Weather Rev. 54. pp. 44–56, Feb., 1926.)—A further contribution to the study of periodicities in world rainfall [see Abstract 804 (1925)], in which periods between nine and two and one-sixth years are considered. The periodograms for all regions studied show periods which approximate closely to harmonics of the sunspot period, and although the available evidence is insufficient to determine whether the periods are constant or varying, periods of practically constant length, but possibly with varying amplitude, seem most probable. Results obtained from the periodogram for an insular climate are more definite than those obtained from continental regions. A. W. L.

2279. *Criteria of Reality in the Periodogram.* **D. Alter.** (Monthly Weather Rev. 54. pp. 57–58, Feb., 1926.)—The author reviews Walker's development of a criterion for reality of periods indicated by the periodogram, and discusses the number of independent terms which should be considered in the analysis. It is shown that this number should be less than the number of computed points in the periodogram, and greater than the number of Fourier harmonics in the stretch of data. A. W. L.

2280. *Influence of Wind on the Level of the Barometer at High Stations.* **G. v. Elsner.** (Meteorolog. Zeits. 43. pp. 201–206, June, 1926.)—Values of pressure at Schneekoppe reduced to the level of Zillerthal and at Brocken reduced to the level of Wasserleben indicated a close connection between the pressure differences and the wind speed at the higher level. At Schneekoppe it was possible to obtain simultaneous records of wind and pressure, and comparison of the curves showed that the changes took place simultaneously. Values are tabulated, for several occasions, of (1) the pressure difference between Schneekoppe and Arnsdorf (reduced), (2) the difference between the mean of the temperatures at these stations and the reduced barometric mean temperature, and (3) the wind speed. These show that if the pressure at Schneekoppe were real, an impossible temperature distribution would be required between it and Arnsdorf. For the Brocken the effects were also noticed, but the results are not so easy to handle. Exner's expression for the pressure difference at the two stations, $(c^2 - c_0^2)/2g$, where c and c_0 are the wind velocities at the upper and lower stations respectively, agrees well with the results for smaller wind velocities, but for higher values the expression given by Anderkó is required. The effects are caused by suction action of the wind on the buildings, and temperature errors cannot explain the result, as it is also found at the Eiffel Tower, where such errors would be small. S. R. R.

2281. *Photographs of Atmospheric Reflections on Alpine Ridges.* **A. Wegener.** (Meteorolog. Zeits. 43. pp. 207–209, June, 1926.)—Four photographs are reproduced to illustrate reflection of Alpine mountain ridges. The author examines in detail the structure of the atmosphere on these occasions, particularly the evidence for a temperature inversion in the anticyclone then existing in these parts. The general theory advanced by the author for the explanation of these reflections is applied and the inclination of the surface to the horizontal found. This angle was found to be less than on occasions when a similar phenomenon was observed by the author in Greenland. R. S. R.

2282. *Extrapolation of Smoothed Pressure Waves.* **S. Evjen.** (Meteorolog. Zeits. 43. pp. 209–213, June, 1926.)—For twenty-four stations scattered over North-West Europe the author has obtained for a period of twelve months mean values for each successive six days of the morning values of pressure. These values were charted and isobars drawn. On account of difficulties in using these curves directly for forecasting, difference charts of the first, second and other derivatives are obtained, and from these, the author states, an idea can be gained of the movement of the main high and low-pressure areas in the region considered. The method employed to obtain the various derived curves is explained. Taylor's theorem has also been employed to extrapolate from the individual pressure curves of any one station and obtain the first and second derivatives. If these curves are considered in three dimensions, one can study the changes along a meridian or any other line along the chart, and then by extrapolation follow the changes with time along this line or across the chart. [See also Abstract 471 (1926).] R. S. R.

2283. *Relation between Barometric Pressure and Gas Pressure in Mines.* **H. Harries.** (Roy. Astron. Soc., M.N. Geophys. Suppt. 1. pp. 307–318, June, 1926.)—For two British mines, 150 miles apart, a comparison was made over a period of two months of variations in the pressure of gas imprisoned in hermetically sealed chambers at depths of 1500 and 711 ft. below pit-head and of 1300 and 386 ft. below sea-level respectively. Pressure was measured by a U-tube containing water, one arm of the tube projecting into the chamber. The gas pressure was correlated with atmospheric pressure at the pit-head, and a close connection was shown to exist between the behaviour of distantly situated volumes of gas in the earth's crust, and this in turn is closely associated with the well-defined changes in the atmospheric pressure at the earth's surface. It is concluded that under the immense changes of weight indicated by the barometric variations, the earth's crust undergoes a wave-like variation of level, and by the depression of this level under high atmospheric pressure the magazines of gas are compressed, resulting in gas being driven from the rock strata into the mine workings. R. S. R.

2284. *Reflection and Refraction of Elastic Waves.* **H. Jeffreys.** (Roy. Astron. Soc., M.N. Geophys. Suppt. 1. pp. 321–334, June, 1926.)—The types of waves dealt with are the P (longitudinal), SV (transverse and in the vertical plane through the ray), and SH (distortional and having transverse horizontal movement). The behaviour of these elastic waves at surfaces where the mechanical properties of the medium undergo sudden changes is of interest in its application to seismic waves. The surfaces of special importance in this connection are (1) the land surface, (2) the bottom of the ocean, (3) the base of the granitic layer, (4) the

Wiechert transition, at a depth of about 0·2 of the radius, where the density appears to increase suddenly without any corresponding change in the wave velocities, and (5) the transition discovered by R. D. Oldham and further investigated by B. Gutenberg at a depth of about 0·5 of the radius. Below this the distortional waves are apparently not transmitted, and the velocity of the compressional waves is only about two-thirds of that just above. Part of the investigation was completed by C. G. Knott [Abstract 1633 (1899)], but the problem is revised by the author particularly for the base of the granitic layer in the light of more recent knowledge of the properties of the layers affected. Expressions are obtained for the reflection and refraction of each type of wave under the several conditions specified, and the fractions of the energy transmitted and reflected are determined in the different cases. The problem of the interface between two slightly different media is also taken, as this leads to the case of a gradual transition layer. R. S. R.

2285. *Amplitudes of Bodily Seismic Waves.* **H. Jeffreys.** (Roy. Astron. Soc., M.N. Geophys. Suppt. 1. pp. 334–348, June, 1926.)—The results obtained in another paper [see preceding Abstract] are here made use of to determine the intensity of the wave coming to the surface from the epicentre in terms of the epicentral distance, the radius of the earth, the time of transmission, the angle the seismic ray makes with the surface, and the velocity of the waves of the type considered in the outer layer. The cases taken are for a shock originating at or near the surface of a homogeneous sphere, at the surface of a heterogeneous sphere, and for compressional waves near the anticentre. As the surface layer is not uniformly present under oceans and on continents its effect is examined. For an explosion at the surface the loss of energy upwards or downwards is tabulated for different directions. It is shown that both the amplitude of the emergent wave and that of the horizontal movement produced are much less than for a homogeneous earth, and also that they are decidedly less at all epicentral distances when the surface layer is taken into account. The reflection of compressional waves at the outer surface or at the base of the granitic layer in general gives further compressional waves. Finally, the results are tabulated and are discussed in relation to those obtained by Macelwaine, Geiger, Gutenberg, Mohorovičić and Turner. R. S. R.

2286. *Effect of a Compressible Ocean on Rayleigh Waves.* **R. Stoneley.** (Roy. Astron. Soc., M.N. Geophys. Suppt. 1. pp. 349–356, June, 1926.)—Bromwich has investigated the effect of an incompressible ocean on the propagation of Rayleigh waves. In this paper the ocean is considered compressible. The modifications introduced are small, but there is the physical possibility of the formation of quasi-nodal planes. Gravity affects the wave velocity but not the group velocity. **H. Jeffreys** contributes a note pointing out that the author's equations admit of the proof of the existence of a minimum group velocity. The frequency seems to be too high to be of seismological importance. A. Wh.

2287. *Elastic Yielding of the Earth.* **R. Stoneley.** (Roy. Astron. Soc., M.N. Geophys. Suppt. 1. pp. 356–359, June, 1926.)—The elastic constants of the earth are calculated on Wiechert's hypothesis from Knott's values of wave velocities, and the deformation of a spherical earth by a disturbing potential represented by a second degree zonal harmonic is obtained. Part of the term $(C - A)/A$ is calculated and the corresponding quantity obtained from the precessional constant and the free period of latitude variation. The agreement is fairly good. A. Wh.

2288. *Rigidity of the Earth's Central Core.* **H. Jeffreys.** (Roy. Astron. Soc., M.N. Geophys. Suppt. 1. pp. 371–383, June, 1926.)—The increase of density towards the centre of the earth may be attributed partly to compression under the weight of the overlying matter and partly to a concentration of the heavier constituents towards the centre, the latter being the more important. Many earlier experimenters determined the rigidities of the outer and inner layers of the earth by using the period of free variation of latitude and the amplitudes of certain tidal movements. Velocities of secondary waves of earthquakes combined with the Wiechert law of densities give values for the rigidity substantially greater than those found to be consistent with tidal data, and thus a modification of former views regarding changes of rigidity is necessary. Later measurements indicate that if the Wiechert density law is to be retained most of the matter constituting the central core must be practically devoid of rigidity from the point of view of the theory of tides and the variation of latitude. If any material is devoid of rigidity, S-waves are not transmitted, and thus the outer boundary of this core is given by the discontinuity found by Oldham and confirmed by Gutenberg, and the depth is rather accurately known as $0{\cdot}455a$. This leads to quite probable values for the density of the core, and thus the Wiechert and the Oldham-Gutenberg discontinuities are identical. Making justifiable allowances on the hypothesis that the rigidity of the core is zero, reasonable harmony is obtained with the data provided by tides and the variation of latitude. An examination of the elastic stability of the earth shows that incompressibility would maintain stability for radial displacements even if the rigidity were zero everywhere. It is concluded that there is no reason to deny that the earth's metallic core is truly fluid. R. S. R.

2289. *Tides and Asymmetrical Space.* **E. Esclangon.** (Comptes Rendus, 183. pp. 116–118, July 12, 1926.)—Observations of the tides at Pola from 1898 to 1916 are well represented by an expression of which one term is not explainable on the usual lines. It is suggested that an apparent asymmetry of space due to high velocity would produce such an effect. It is desirable to obtain confirmation from other stations and over other periods in order to rule out such effects as long-period variations in barometric pressure. A. Wh.

ASTRO-PHYSICS.

2290. *Orbits Asymptotic to the Straight Line Equilibrium Points in the Problem of Three Bodies in which the Finite Bodies are Oblate Spheroids.* **J. F. Brown.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 69–88, Jan., 1926.)—For two spherical masses revolving about each other in circles there are three points on the straight line through their centres to which certain orbits of an infinitesimal body are asymptotic. This paper, which is entirely mathematical, shows that there are similar points when

the masses are oblate spheroids whose axes are normal to the plane of their orbits. The asymptotic orbits in this case are also examined.
A. Wh.

2291. *Isosceles Triangle Solutions of the Problem of Three Bodies.* **Charlotte I. Johnston.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 259–274, Jan., 1926.)—Two bodies are oblate spheroids of equal mass. In the first case considered they are constrained to move in a circle, while the third body is infinitesimal. In the second case the circular motion of the two bodies is initial only, and the third body is a finite sphere. The orbits of the third body lie on a straight line perpendicular to the plane of the orbits of the spheroids and equidistant from them. Entirely mathematical.
A. Wh.

2292. *Physical Nature of the Solar Corona. Part IV.* **W. Anderson.** (Zeits. f. Physik, 37. 4–5. pp. 342–366, 1926.)—The author uses the same method as in Part III [see Abstract 971 (1926)] for the deduction of the intensity distribution in the electron gas corona for distances less than the sun's radius from the photosphere, and thereby shows that the temperature radiation must also be considered. If a definite assumption is made for the percentage composition of the radiation at a definite point in the corona, then a tolerably good agreement can be obtained between observed and calculated values. A new explanation is given of the disappearance of the dark Fraunhofer lines in the inner corona, and a calculation is made as to the limiting distance from the sun's edge at which these lines must remain invisible. The great difficulties of an electrostatic character presented by the theory of an electron gas corona are discussed and an explanation derived of Moore's observation of the slow striation of the corona material. The paper concludes with arguments in favour of the author's theory regarding the nature of the corona.
S. G. B.

2293. *Discussion of the Greenwich Observations of the Sun, 1836–1923.* **H. S. Jones.** (Roy. Astron. Soc., M.N. 86. pp. 426–438, April, 1926.)—These observations are examined and compared with Newcomb's tables, in order to derive corrections to his elements, and also in order to discuss the motion of the equinox. It is found that the following corrections are required:—

Mean longitude	$+ 0''\cdot47 + 0''\cdot34\,T$
Eccentricity	$- 0\cdot06 - 0\cdot115\,T$
Perihelion	$- 1\cdot0 - 13\cdot8\,T$

where T denotes centuries from 1900·0. There are residual systematic fluctuations in the observed mean longitude, which have an extreme amplitude somewhat exceeding one second of arc. A correction to Newcomb's mass of Venus gives a value of 1/404,700. The correction required for the motion of the equinox is very small, but a longer period of observation, with the impersonal micrometer, is necessary to determine it with precision.
M. A. E.

2294. *Some New Possibilities in Solar Research.* **G. E. Hale.** (Nature, 118. pp. 1–8, July 3, 1926. Supplement.)—The author reviews very briefly the discoveries of pioneers in solar research with the spectroscope, and the construction by Young of an instrument with oscillating slit which was the forerunner of his own spectrohelioscope now working in Pasadena. Some of the results obtained with this instrument and with the spectroheliograph, and the special uses of both, are described. The paper is copiously illustrated. **M. A. E.**

2295. *Structure of the Hα Line of the Chromosphere.* **G. Abetti.** (Acad. Lincei, Atti, 3. pp. 594–599, May 16, 1926.)—The second slit of a spectroheliograph is opened to about 6 mm. and the limb of the solar image adjusted till the first slit is tangential to it. Photographs can then be taken of the Hα line at any desired point. Calling the centre of the reversal $H\alpha_3$ and the bright line in the midst of the reversal $H\alpha_2$, an attempt is made to connect the dissymmetry with the physical conditions of the chromosphere. The dissymmetry appears to be constant within the limb. It is concluded that the intensities and widths of $H\alpha_2$ and $H\alpha_3$ afford a measure of the activity of the chromosphere. Other spectral lines could be treated in the same way. **A. Wh.**

2296. *Probable Age Limits of the Planetary System from Radiation Theory and Cosmological Data.* **E. Belot.** (Comptes Rendus, 182. pp. 1327–1329, May 31, 1926.)—By various independent computations the author arrives at the age of the present planetary system as 330 million years. He answers the objection that for pre-Cambrian radioactive rocks an age of 1500 million years is required for the earth, by urging that Strutt, Joly and Holmes have not taken into account that radio-activity does not go deeper below the earth's surface than 16 to 20 km., and that these surface rocks were formed by the rapid solidification of the terrestrial kernel in passing through the primitive nebula from which it acquired the radio-active materials limited to its surface. This age of 1500 million years is that of the primitive nebula, not of the earth itself, according to his reckoning. **A. S. D. M.**

2297. *Means for Improving Lunar Coordinates deduced from Stellar Occultations.* **G. Bigourdan.** (Comptes Rendus, 183. pp. 169–171, July 19, 1926.)—Occultations of stars by the moon may be observed to about $0^{s}\cdot 2$, which should give (but does not) lunar longitudes to nearly $0''\cdot 1$. This is due to the irregularities of lunar relief, which has at the point of occultation a contour, varying with libration, and this mean irregularity may exceed 1″, giving phenomena such as double disappearances or reappearances near positions angles 0° and 180°. The author suggests forming new model globes of the moon, using photographs taken at selected moments with telescopes of long focus, and employing recent applications of the stereoscope, which allow terrestrial contours to be traced in a continuous manner. Such globes should be inclined so as to correspond to the libration of the required moment, past or future, of the occultation, with its relief the same as the border of the lunar disc as seen from the observer's place on the earth. He details the advantages in thus correcting observations. **A. S. D. M.**

2298. *Thermodynamic Equilibrium of a Star.* **A. Véronnet.** (Bull. Astronomique, 5. 2. pp. 185–217, 1925.)—The first part of the paper develops the general expressions connecting the variables and defines the different limited conditions of equilibrium that can be investigated by making various assumptions as to its nature. The gas law assumed is $P(V - b) = RT$, and the cases of isothermal and homogeneous equilibrium are treated. It is concluded that in any form of equilibrium there will be a central region substantially homogeneous and isothermal overlain by a region with the general characteristics of an atmosphere. It is considered that the mechanism of thermal transfer is convective. The paper is very full, and should be consulted. A. Wh.

2299. *Declinations and Proper Motions in Declination of* 1738 *Southern Stars, mostly between* — 30° *and the South Pole, for the Equinox of* 1900. **J. E. de V. van Steenwijk.** (Roy. Astron. Soc., Mem. 64. 2. pp. 27–46, 1926.)—The object of this catalogue is to strengthen the data in Boss's Preliminary General Catalogue in that part of the sky where it is weakest. The La Plata Catalogue of 1925 has been compared with older catalogues of Paramatta, Madras, the Cape, Santiago, Melbourne, Sydney, the Argentine, Lick and San Luis. The declinations and proper motions were deduced by a graphical process, described in M.N. for January, 1925, and this is found to be very accurate as well as rapid. M. A. E.

2300. *Cepheid Variables.* **J. J. M. Reesinck.** (Roy. Astron. Soc., M.N. 86. pp. 379–380, April, 1926.)—A criticism of a point in a paper by Jeans [see Abstract 1271 (1926)], which showed that the luminosity and temperature of a Cepheid must be in phase with the radius. It is pointed out that this conclusion is really derived from *à priori* assumptions and that the amended treatment does not admit of a positive conclusion being drawn. A. Wh.

2301. *Colour Index and Distribution of Stars.* **G. Shajn.** (Roy. Astron. Soc., M.N. 86. pp. 382–389, April, 1926.)—From the luminosity and density functions of Kapteyn and van Rhijn a relation between the colour index and star distribution in space can be deduced which is in general agreement with the observed facts. With decreasing apparent brightness the mean colour index increases, and the relative frequency of B and A stars is lower in high galactic latitudes than in the Milky Way. Other conclusions drawn are that the integrated spectrum of the Milky Way is of the composite type with predominant solar lines, that for the faintest stars there should be a higher colour index, and that the high frequency of late-type spectra among the faint stars does not indicate that the relative frequency of late-type stars increases with distance. A. Wh.

2302. *Structure of the Solar Cluster.* **R. A. Sampson.** (Roy. Astron. Soc., M.N. 86. pp. 390–414, April, 1926.)—1202 trigonometric parallax stars are grouped according to spectral type and mean density and the distribution with distance plotted. For all groups the same type of curve fits the observations but with different constants, and the smoothness and form of the curves lead to the conclusion that the solar cluster is a reality and the sun is near the centre of it. Assuming that the cluster is spherically symmetrical, the stars are plotted out on random radii, and the resulting diagram shows great resemblance to a cluster. There are, however, hardly sufficient data to determine the real form of the cluster and any spatial differentiation between the constitutent groups. This will be attempted later, as well as the study of the proper motions throughout. The solar cluster thus revealed is considerably smaller than that previously suggested, and may or may not have any relation to the Milky Way. In an addendum the author replies to certain comments advanced by the referees. The first comment suggests that the accidental errors of parallax determination would have the effect of drafting a number of the distant stars into nearer zones, and that an appearance of clustering might be produced by this effect. The author concludes that actually this effect is insignificant. A further objection is that most of the high parallax stars have high proper motions, whereas in a cluster the relative proper motions would be very small, if not absent. The author contends that the only way to reconcile these high proper motions is to consider them orbital rather than independent. He also considers that the use of parallaxes from 0″·00 to 0″·01, while 15 % of the observations show negative values and are rejected, is justifiable, and that these negative quantities arise under two heads, firstly where the error exceeds the true value, and secondly when a definite gross error in selection of the parallax star is made. The first case is covered by the answer to the first comment, while the second obviously demands elimination of the negative and meaningless parallax. Objection is taken to the stress laid on the points of inflection of the curves. It is considered that second differences must be greatly affected by the methods of treatment, and merely express a physical fact. The method is chosen to avoid introduction of artificial features. The final comment is that parallax measurements are usually made on stars which have themselves been selected to some extent according to their proper motion or physical brightness, and consequently are not representative of the whole star system. The author considers that the large number of negative parallaxes shows that this selection is not very definite. Even if such an effect is of importance at the outside of the structure proposed, it will not affect the constitution of the inner layers. A. Wh.

2303. *Precession, Galactic Rotation and Equinox Correction.* **J. K. Fotheringham.** (Roy. Astron. Soc., M.N. 86. pp. 414–426, April, 1926.)—The author discusses the work of Boss and others on the value of precession and the equinox correction, and argues that a new precession on the equator should be adopted, amounting to $-2''\cdot13 \pm 0''\cdot29$ per century. He suggests as its explanation a motion of the plane of the earth's orbit, for which no gravitational cause can at present be assigned. Precessional constants for epoch 1925·0, deduced from this discussion, are given. M. A. E.

2304. *Rotation of Stars and Radiative Viscosity.* **J. H. Jeans.** (Roy. Astron. Soc., M.N. 86. pp. 444–458, May, 1926.)—The idea of radiative viscosity which was developed in an earlier paper [see Abstract 1784 (1926)] is applied to the case of a spherical rotating mass. Most of the paper is mathematical, but the astronomical consequences are discussed. It is found that the angular velocity at any point will nearly be only dependent on the distance from the centre. The star will rotate as a series of spherical shells, each shell having its own velocity of rotation. Viscosity will tend to make this rotation uniform, but radiative viscosity will tend to make it proportional to r^{-2}. The actual curve is shown, the deviation from r^{-2} being small. In the dense central regions of a star the rotations will usually be higher than those given by this expression. A second approximation to the rotational velocity in spherical shells in terms of the latitude λ is of the form $\phi = a + b \sin^2 \lambda$, which agrees with the observed solar rotation. A. Wh.

2305. *W. Herschel's Diffused Nebulosities.* **J. G. Hagen.** (Roy. Astron. Soc., M.N. 86. pp. 548–553, May, 1926.)

2306. *Emission of Atoms from Stars.* **E. A. Milne.** (Roy. Astron. Soc., M.N. 86. pp. 459–473, May, 1926.)—Any atom which is moving outwards from a star under radiation pressure due to a particular absorption line will absorb and be accelerated by a frequency which, by the Doppler principle, will increase with the velocity. Consequently it will move out of the centre of its appropriate absorption line and ultimately attain such a velocity that it will be exposed to the full intensity of the continuous background. If the region of the spectrum is on the red side of the energy maximum, a limiting velocity will be attained which is higher than if it is on the violet side. In general the atom will attain a limiting velocity due to the weakening of the radiation according to the inverse square law. This may be modified by the "trapping" of the atoms by an adjacent absorption line. The limiting velocity can be calculated, and in the case of the sun is about 1600 km. per sec. for an absorption line with an intensity ratio of 1/9. Since the gravitational potential at the surface of stars passes through a wide minimum, this limiting velocity will be of the same order as that appropriate to stars of a wide range of masses. It is noted that the velocity is of the order of that observed as a Doppler doubling in the case of novæ. If it is due to this cause, the absence of any slow shifting out or gradation of the displaced line is explained, the number of atoms having attained their equilibrium velocity being very high in comparison with those approaching it. It is suggested that these results serve usefully to modify Lindemann's theory of auroræ and magnetic storms. On this theory the particles will have a much higher velocity and mass than is possible on Lindemann's, and it is shown that the penetrating power of a Ca^+ ion arriving in accordance with this theory would be sufficient to account for the lower limit of auroræ. This is based on observations of the recoil of argon atoms (of nearly the same weight) from collisions with α-particles. Any absorbing atom or ion may be expelled by this action, but the number so accelerated must not be sufficiently great for them "to carry their absorption line with them." The emitted clouds of positive ions may be accompanied by electrons, but these will probably lag behind into the tail of the cloud. A. Wh.

2307. *Spectrum of ϕ Persei (SP Type BoPE) throughout Complete Cycle* **(1925–1926). W. J. S. Lockyer.** (Roy. Astron. Soc., M.N. 86. pp. 474–498, May, 1926.)—The same instrument and similar plates were used for this cycle (1925, Sept. 9–1926, Jan. 13) as for the previous cycle [see Abstract 2047 (1925)]; 106 photographs are measured, the results being tabulated on pp. 476–480, and form the basis of two curves of the lines H_β and H_γ. The variation period of 126·8 days is confirmed. The curves also show that the amplitude of the H_β curve is greater than the H_γ; that both H_β and H_γ curves indicate closely similar epochs for zero velocity on both upward and downward grades, namely at phases 32, 93 and 94; that both curves reach a little greater distance above the zero line at maximum negative velocity than below at maximum positive, indicating that the line of sight velocity is greater at maximum negative than at positive, if we assume that zero velocity is when the central absorption lies midway between the bright components when these are of equal intensity. This does not accord with facts established by Ludendorff, Cannon, Jordan and Frédette. The author confirms that there is a short period variation of some amplitude superimposed on the primary period, and that the maximum hydrogen absorption epoch precedes the maximum positive velocity by about 14 days, the similar minimum epochs being coincident; he does not confirm a regular variation of one-sixth of the primary variation (126·8 days). When H_γ, H_δ and H_ϵ exhibit greatest absorption, the other hydrogen lines towards the ultra-violet become sharp and well-defined, and are more easily traceable far down the spectrum; he therefore notes on each negative the limiting hydrogen line visible. Between phases 30 and 100, and between 118 and 30, no line could be traced beyond H_λ; between 100 and 118 all showed beyond H_λ, and in the mean to H_θ. The extension of visible hydrogen lines into the ultra-violet is a measure of greater hydrogen absorption in the star. The cyclical changes in intensity of the calcium and helium absorption lines endorse the results of 1924–25, but he now finds that the bright ionised lines do not behave as the hydrogen lines do, but that for λλ4233·8 and 4576·5 the red component is on the average the brighter, and for λλ4179·0 and 4351·9, the violet component; but these changes seem unconnected with phase. On all negatives taken at any phase, in the region between the ionised iron double (λλ4173·5 and 4178·9) and the ionised iron line (λ4238·8), there is almost continuous homogeneous absorption, due probably to contrast, and indicating the absence of many bright lines. A. S. D. M.

2308. *Spectrum of Nova Pictoris.* **J. Lunt.** (Roy. Astron. Soc., M.N. 86, pp. 498–524, May, 1926.)—The four-prism slit spectrograph of the 24-in. Victoria telescope with the short camera and Imperial Eclipse plates were used. The measures were made by the author on the Toepfer machine and reduced by Hartmann's formula. The observations of the nova from 1925, May 25, to 1926, March 13, are divided into eleven periods: (1) Nova fluctuates in light, but period leads up to the first maximum; the spectrum is continuous and crossed by heavy, broad absorption lines; nearly two-thirds are enhanced lines; mean radial velocity (m.r.v.) about − 71 km./sec. (2) Very important transition period, from June 8–10, coinciding with the greatest light maximum; violent changes and spectrum displaced to the violet; m.r.v., − 81 and − 291. (3) Rapid drop in magnitude; lines narrower and sharper than in (1); spectrum comparable to that of Canopus; m.r.v. of principal spectrum, − 306. (4) Includes first minimum; continuous spectra diminished; bright lines emerge definitely; m.r.v., − 320. (5) Magnitude rising to second maximum, which is flat; continuous spectrum brightens, and dark lines reappear; three-fourths are enhanced; m.r.v. of continuous spectrum, − 320. (6) Extraordinary behaviour of hydrogen lines, of which there are minor explosive outbursts; m.r.v., − 320. (7) Transition period with abrupt change in principal spectrum, and in m.r.v. to − 400 km./sec., due perhaps to faster-moving material drifting between us and the nucleus. (8) Bands of unknown origin, like those in η Argûs, becoming evident; m.r.v. still − 400. (9) Variable dark helium spectrum appears with the same large displacement as in the hydrogen lines; η Argûs bands developed; m.r.v., – 405. (10) Characterised by strong bright hydrogen lines, with further development of η Argûs bands; dark lines give m.r.v., – 411, but gradually vanish; H_γ and H_ϵ give m.r.v. – 1455. (11) Signs of transition to a more normal late stage nova spectrum; H_γ, H_δ, H_ϵ and H_ϵ λ3965 give m.r.v. – 436 km./sec.; the bands show maxima near edges, the centre being at zero radial velocity. The author discusses the nova theory, and concludes that Nova Pictoris shows us a slow-motion picture of the process of a star which "swells up and bursts." He considers that period (2) gives the real crisis in its history, and that the root cause of the heating up of a nova is release of atomic energy, or atomic rearrangement. The evidence for stationary H and K lines is very weak in this case. A. S. D. M.

2309. *Line Absorption in G-, K- and M-type Spectra.* **F. E. Baxandall.** (Roy. Astron. Soc., M.N. 86. pp. 524–542, May, 1926.)—In these types line spectra vary little, though banded spectra vary much. The author gives an outline of previous work by himself and others, and investigates photographs taken in 1902, with a four-prism slit spectrograph on the Newall telescope, of the spectra of α Boötis (K_0), α Arietis (K_2), α Tauri (K_5) and α Orionis (Ma), together with the Sun (G_0). An intercomparison was made of the two first spectra with the second two, and a table is given of wave-lengths, intensities and probable origins of lines. From this he finds that 84 lines are considerably strengthened from G_0 to K_5, and that the elements Fe, V, Cr and Ti take a prominent part; Ti + also appears to supply a large number of strengthened lines, but this is due to blending with lines of Fe, Ti, Cr or Sc. Comparing the strengthened lines with King's temperature classes, most of them belong to a low or to a medium temperature type. For lines strengthened from Ko to Ma, there are 53, and again the same elements predominate; it results that low temperature lines prevail in the strengthened stellar lines whether blended or unblended. There are 44 lines weakened from K_0 to Ma, and in these iron and hydrocarbon are conspicuous. The changes in intensity in the hydrocarbon band are best traced by the changes in a small detached portion near λ4324. This forms an important criterion in placing the subdivisions of lower-type spectra in their proper sequence. Although the hydrocarbon band drops in intensity along the branch K–M, on the other recognised branch, K–R, it is far more prominent in the R than in the K stars, so that it is not possible to place G, K, M and R stars in one sequence. From the iron lines there is some evidence to show that the weakened stellar lines relate to high-temperature lines as distinguished from the low temperature of the strengthened stellar lines. A. S. D. M.

2310. *Diffuse Matter in Interstellar Space.* **A. S. Eddington.** (Roy. Soc., Proc. 3. pp. 424–456, July 2, 1926.)—Estimates of the density, temperature and state of ionisation of interstellar matter are made. Two methods give the order of the density. Firstly, the observed proper motions of the stars can be interpreted as orbital motions in a uniform gravitating medium. This leads to a value of 10 hydrogen atoms or $1{\cdot}66.10^{-23}$ gm./c.c. as an upper limit. Taking this value, an average atomic weight 20, and assuming that the material is ionised, the free path for ions is 10^8 km. and time 1 year, for electrons $5{\cdot}2.10^8$ km. and 10 days, while an ion encounters an electron about once in 5 days. These encounters are sufficient to ensure a Maxwellian distribution of velocities. Another density estimate can be made by assuming the diffuse nebulæ to represent local but continuous condensations. The equilibrium of the nebulæ is assumed to be isothermal and at about 10,000°. Theory then gives the density at a distance of 150 parsecs, 10^{-24} gm./c.c., and this is probably a fairly accurate estimate of the mean value. By the same theory the central density of a nebula will be 10^{-20} gm./c.c.

The temperature of the interstellar material is rather more difficult to estimate. The black-body temperature of a body in equilibrium with starlight is only $3°{\cdot}2$ abs. The selective absorption of the material will enable a far higher temperature to be attained. Every frequency will correspond to a different equilibrium temperature, and the net result has to be estimated. Of the four possible modes of energy transfer, (*a*) photoelectric ionisation, (*b*) orbit switches, (*c*) line absorption, and (*d*) electron scattering, (*c*) and (*d*) will be negligible in regions of low density. The full discussion of (*a*) and (*b*) is complex, but it is estimated that the temperature will be of the order of 10,000°. The idea underlying this estimate is that the velocity of emission of a photoelectron depends on the frequency rather than the intensity of the radiation.

The degree of ionisation is given by equating the number of captures to the number of expulsions of electrons. The former is proportional to the electron density, the latter to the radiation density. Multiplying the electron density by a factor sufficient to bring up the radiation density to the equilibrium value enables the degree of ionisation to be calculated. Atoms are ionised down to a value of the order of 15–20 volts.

As consequences of interstellar matter are discussed its absorption spectrum, in which lines of calcium will be predominant with sodium of secondary importance. These lines are sometimes shown by spectroscopic binaries as not partaking of the shift due to the radial motion of the system. The most potent form of scattering, electron scattering, will account only for a coefficient of $0{\cdot}0000067$ per 100 parsecs. The absorption of dark nebulæ is awkward to explain, but may be molecular, though no traces of band absorption through them has been observed. The accretion of stellar mass from interstellar material is shown to be far less than the loss by radiation, while resistance to motion will be negligible. The evolution of nebulæ as local condensations from a primitive uniform material of density 3.10^{-24} gm./c.c. leads to masses of the right order for the limiting size of star clusters. The evolution of sub-condensations is not so satisfactory, as the isothermal condition will no longer be realised. The evolution of a star appears to follow the line: Condensation as a nebula at 10,000°; density rises and temperature falls to a low value while opacity becomes high, permitting the retention of heat generated by contraction; at a certain stage the density becomes high enough to enable radiation due to sub-atomic processes to be scattered, and thus admits a further available source of heat.
A. Wh.

LIGHT.

2311. *Huygen's Principle.* **F. Croze.** (Ann. de Physique, 5. pp. 371–439, May–June, 1926.)—A very long memoir discussing the work of Poisson, Poincaré, Helmholtz, Kirchhoff, Rayleigh, Gouy, Brunhes and Fresnel on the analytical expression of Huygen's principle and forming a useful summary of the problem. W. H. Gr.

2312. *Evening and Morning Phenomena.* **P. Barreca.** (N. Cimento, 3. pp. 153–168, April, 1926.)—The sky at sunrise and sunset is furrowed by invisible coloured bands arranged in two spectra one above the other, and each with its red nearest the earth. These spectra are only revealed on the intrusion of small clouds or dust. The order of coloration is the same at sunset and sunrise. It is not to be confounded with the general sky coloration produced indirectly by white light. A. D.

2313. *So-called Black and White Contents of Pigments in Ostwald's Colour System.* **C. Schaefer.** (Phys. Zeits. 27. pp. 347–353, June 1, 1926.)—It has been assumed hitherto that the addition of black to a coloured pigment has no effect beyond darkening the colour. According to Ostwald the effect is a totally different one. Kohlrausch [see Abstract 70 (1921)] has shown that Ostwald's so-called measurement of the black and white contents must be rejected, if only for the reason that it rests on only two points of the remission function (maximum and minimum) instead of on the whole remission curve. The author carried out a series of top experiments which led to the following conclusion: There can be no doubt that the addition of a black sector has no effect beyond darkening, which may therefore be compensated by stronger illumination. This entirely agrees with the prevailing conception, and completely contradicts Ostwald's. Reference is made to the similar experiments carried out with the same object and the results by Exner [*Wiener Berichte*, IIa. 127, p. 1829, 1910]. The paper contains numerous figures and curves and is largely mathematical. E. F.

2314. *Chromophoric Superposition in the Molecular Strain Theory of Colour.* **S. Dutt.** (Chem. Soc., J. pp. 1171–1184, June, 1926.)—Deals with the preparation and measurement of absorption maxima of four series dyes in an attempt to show that selective absorption is due to molecular strain, *i.e.* distortion of the normal valency directions produced by formation of (i) a double or triple bond, (ii) a cyclic from an open-chain compound, or (iii) by unequal distribution of the masses attached to the atom. The amount of strain is roughly proportional to the angular displacements of the valency directions of the atoms. Strain in a molecule can be intensified by loading, especially when the load is near the centre of strain. The position of the absorption maximum of a dye-molecule containing two different and distantly situated chromophores is approximately the mean of the positions of the maxima of the two components of the dye, each containing one chromophore. W. H. Gr.

2315. *Discoloration and Luminescence of Glass by Cerium.* **F. Eckert.** (Zeits. techn. Physik, 7. 6. pp. 300–301, 1926.)—Preliminary communication. When alkali-borate glass is mixed with a little cerium salt (the preparation contained 85 % of Ce_2O_3, rest lanthanum and didymium) it turns brown in daylight, exposed to a quartz-mercury lamp in a few moments; there is further bluish fluorescence and phosphorescence, the latter being intensified and then extinguished by heat. The glass (from the Sendlinger works) contained less than 0·01 % of Fe; decolorising agents (Se, Co, Mn) were absent, but a few tenths per cent. of As_2O_3 present. Barium and lead suppressed the effect; 0·1 % of Ce was sufficient to produce it, 3 to 4 % prevented it. X-rays did not discolour the Ce (or Did.) glasses, and the discoloration by X-rays was not observed either in the presence of coloured oxides of heavy metals, Fe, Cu, Ni, V, etc., if they coloured the glass; the cerium may decompose the oxides. It is also noteworthy that cerium-glass melts effervesce (probably by CO_2 liberation) at relatively low temperatures. H. B.

2316. *Some Modern Absorption Glasses.* **G. Jaeckel.** (Zeits. techn. Physik, 7. 6. pp. 301–304, 1926.)—Some details of the spectra of glasses from Sendlinger, permeable to ultra-violet rays in thicknesses up to 4 mm. are first given. The special U.V. black glass is a crown containing nickel oxide, and is permeable only to the extreme red and violet. It is used, *e.g.*, for analysis by means of quartz lamps, for revealing the faint fluorescence of many substances, and especially also for stage effects, according to Saubermann's patents; the artists and their garments are painted with fluorescent materials, which appear self-luminous on a dark background, while the body gives no shadow. Secondly, absorption glasses and their fluorescence are noticed. With the black glass mentioned, cerium gives a blue fluorescence and vanadium a greenish-brown; yellow (cadmium sulphide) glasses appear yellow to red, but only after heating up to 640 to 720°; the tint may locally be varied by heating different portions to different temperatures. That the fluorescence shifts towards the long-wave side with temperature is ascribed to the increased growth of colloidal glass. H. B.

2317. *Limiting Angle of Regular Reflection.* **F. Jentzsch.** (Zeits. techn. Physik, 7. 6. pp. 310–312, 1926.)—The limiting angle, i, for regular reflection is defined as that for which the given path difference, $\Delta = 2h \cos i$, for two rays, one reflected from the raised and one from the lowered part of the rough surface, is so small that regular reflection occurs, h being the vertical distance between the upper and lower parts of the rough surface. Rayleigh has given for the limiting case $\Delta = \lambda/4$. Instances are quoted by which the facts may be readily observed. This limiting angle is measured directly by setting up the surface to be tested in a carrier on a turntable by which the surface may be brought into the axis of rotation and any part of it tested. Light from a Nernst lamp is concentrated on a finely divided scale, and this light reflected by the surface under test into the eyepiece. The basic equations are found to be true, and i can be measured very accurately. It is shown that during the grinding of an optical surface the unevenness is first quickly and then slowly removed, and a limiting value is reached which depends for its magnitude on the nature of the grinding material used. R. S. R.

2318. *Most Suitable Choice of Wave-Length and Light Source for the Measurement of Refractive Indices.* **F. Weidert.** (Zeits. techn. Physik, 7. 6. pp. 304–310, 1926.)—The author reviews critically the existing system of standard spectral lines (A′CDFG′) and the means of reproducing them. He states the following conditions which should be satisfied: (1) Simple line structure, (2) well-separated positions in the spectrum, (3) isolated positions, (4) ease of identification, (5) sufficiently bright, (6) ease of reproduction and certainty of management. No existing light source satisfies all of these conditions. It is suggested that an International Commission should elaborate and introduce a more satisfactory system of standard lines. Until that time he advises the use of a quartz-Hg vapour lamp and the use of the lines with wave-lengths 6907, 6234, 5461, 4916, 4358, 4047 Å., and to interpolate in this system the refractive indices for other lines. On the basis of the Hartmann four-constant interpolation formula functions were stated from which the author has calculated tables which permit the expression of these interpolations with greater exactness in the shortest time. The tables also yield immediately the Hartmann constants λ_0 and α, so that from the measured Hg lines the refractive indices for other alternative wave-lengths can be calculated quickly. R. S. R.

2319. *Refractive Index of Glass at High Temperatures.* **C. G. Peters.** (Bureau of Standards, Sci. Papers, No. 521. pp. 635–659, 1926.)—Deals with the determination of the refractive index of glass over a wide range of temperatures extending to about 700° C. An interference method is used in which the two nearly parallel surfaces of a plate of the glass are placed in contact with two interferometer mirrors so that two adjacent sets of fringes are visible. Both the initial value and the change with temperature of the refractive index and also the thermal expansion of nine different samples of glass, including flints, crowns, and pyrex, were measured. At about 500° C. there is a critical region where the expansion rate increased by two to seven times. The refractive index increased up to this region, then decreased in the rapid-expansion region and increased again above the softening temperature. The measured index is larger than the index computed from the density, and the difference between the measured and computed indices increased with temperature at a nearly constant rate. This increase is probably produced by the same cause which shifts the absorption band towards the larger wave-length region. W. H. Ge.

2320. *A New Refractometer.* **H. Schulz.** (Journ. Sci. Instruments, 3. pp. 301–303, June, 1926.)—A new form of refractometer on the total reflection principle is described and its performance discussed. Author.

2321. *Deflection of Bars.* **J. H. Dowell.** (Journ. Sci. Instruments, 3. pp. 305–308, June, 1926.)—The question of the best position of the supports of bars for accurate optical benches, such as étalon mounts, is considered, and the deflection of the bars is calculated and depicted. Author.

2322. *Note on Microscope Tube Length.* **T. F. Connolly.** (Journ. Sci. Instruments, 3. pp. 337–342, July, 1926.)—The effect of the tube length of microscopes as regards their performance with dry and immersion objectives is discussed, and a fixed tube length is advocated for all but special work. Examples of modern microscopes, in which a fixed tube length has been adopted, are referred to. AUTHOR.

2323. *Apparatus for Analysing Feebly-polarised Light.* **B. Lyot.** (Rev. d'Optique, 5. pp. 108–118, March, 1926.)—The Savart polariscope cannot detect a polarisation of less than 1 %, but its sensitiveness can be increased by superposing the polarisation of a sloping glass plate with that of the light to be studied, and in this way 1 part in 1000 of polarised light can be detected. In the same way an ellipticity of 1/20 can be detected when the proportion of polarised light is only 1/100. The degree of polarisation of light reflected from various solids was found to vary greatly with the angular distance between the source of light and the polarimeter as viewed from the reflecting or diffusing surfaces. Curves were plotted showing a maximum of polarisation at a certain angle, and in some cases a reversal of sign (not previously recorded) was observed in the light reflected from coloured substances. A curve of this type, showing a reversal of sign at 24° and maxima at 10° and 100°, was found for light reflected from the moon. Mercury and Mars observed within a limited range of angles give almost identical curves, but Venus, Jupiter and Saturn gave totally different results.
T. M. L.

2324. *Testing Prisms and Glass Plates.* **A. Aubertin.** (Rev. d'Optique, 5. pp. 161–182, April, 1926.)—Gives geometrical and interference methods for exact measurement of the right angle of a totally reflecting prism and of the angle between the faces of a plate of glass. By the use of very fine pencils of light defects in the pieces studied can be localised. The paper is well illustrated, and examples of various special cases are given. W. H. GE.

2325. *Correction of Spherical Aberration.* **H. A. McTaggart.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 139–142, Jan., 1926.)—Correction of spherical aberration of a rim-ray of a chosen colour in achromatic doublet objectives with lenses of a finite thickness. A. D.

2326. *Thermal History and Optical Constants of Glasses.* **F. Eckert.** (Zeits. techn. Physik, 7. 6. pp. 282–287, 1926.)—The refractive index of a glass depends upon the time the glass had remained in the plastic condition. The optical constants depend upon the recent thermal history. The homogeneity of an optical glass melt measured; rules for the reproducibility of three melts under similar conditions. A. D.

2327. *Earthenware Glazes.* **E. Zschimmer and E. Leonhardt.** (Zeits. techn. Physik, 7. 6. pp. 287–290, 1926.)—A study of the behaviour of Segel pyramids made up of various glazes with various additions. A. D.

2328. *Signal Green Glass.* **E. Zschimmer, C. M. Grisar and H. Meess.** (Zeits. techn. Physik, 7. 6. pp. 290–300, 1926.)—Glasses of various composition containing 4·5 % of CuO; absorptions of blue and red; guides to an ideal signal green glass. A. D.

2329. *Perot and Fabry's Fringes obtained with a Double-refracting Semi-silvered Lamina.* **O. M. Corbino.** (Accad. Lincei, Atti, 3. pp. 573–

576, May 16, 1926.)—Ordinary interference fringes in a lamina of a certain thickness acquire important characteristics when the reflecting power of the two faces of the lamina is somewhat high. In such a case the simple interference between two waves is replaced by a more complex interferential phenomenon resulting from the superposing of various waves which undergo multiple reflection between the two faces and which therefore have a decreasing amplitude and constant phase shifting. The author here examines mathematically the characteristics shown by the fringes obtained with a Perot and Fabry semi-silvered double-refracting lamina whose optical axis is parallel to its faces. E. F.

2330. *Ghosts due to Aperiodic Ruling Errors.* **E. Buchwald.** (Ann. d. Physik, 80. 3. pp. 279–296, June 2, 1926.)—Aperiodic errors in ruling of a diffraction-grating lead to a continuous background, which increases in intensity with increasing angle of diffraction. In actual cases fluctuations from the mean occur, giving rise to a mottled effect; in extreme cases of fluctuation ghosts may be produced. The probability is calculated for a given grating and a given spectral region that the intensity due to this cause shall exceed a given intensity, and, further, the probable number of ghosts of this type in a given angle. A. C. M.

2331. *Improved Grating for Vacuum Spectrographs.* **R. W. Wood and T. Lyman.** (Phil. Mag. 2. pp. 310–312, July, 1926.)—The corrosion of metal gratings suggested the use of gratings ruled on glass which were intended to be coated with a metallic film which could be renewed. Owing, however, to the decreasing reflection coefficients of metals and the increasing coefficient of transparent substances, it was thought worth while to try such a grating uncoated. The grating is ruled with a very light touch, and then etched by a process previously described [see Abstract 232 (1907)]. The comparison of behaviour with that of a speculum grating did not allow a statement of relative efficiency between 1900 Å. and 1400 Å. Below 1300 Å., and especially below 500 Å., the glass grating gave a much more intense spectrum. This is shown by reproduction of the copper spark taken with the same time of exposure with the two gratings. F. S.

2332. *Intensity Coupling in Opalescence-Fields.* **E. Buchwald.** (Phys. Zeits. 27. pp. 353–361, June 1, 1926.)—A grating with unsystematic errors gives a granulated background, the opalescence-field, whose brightest points are aperiodic ghosts of the grating. Every point of the opalescence-field is, as regards its intensity, coupled with every other point. This is only noticeable, however, in the neighbourhood of a doubled angular distance between two neighbouring minima and at certain symmetrically situated mutually distant points; the former gives the breadth of one of the aperiodic ghosts, the latter the regular recurrence in the field. A. D.

2333. *Disperson of Carbon Disulphide.* **G. Bruhat and M. Pauthenier.** (Ann. de Physique, 5. pp. 440–469, May–June, 1926.)—Deals with the unsatisfactory nature of the dispersion formulæ for carbon disulphide in the ultra-violet region near the absorption band (320 $m\mu$). Measurements of absorption have been used to calculate the terms in the Ketteler-Helmholtz formula relative to this band. In the region from

$\lambda = 255$ mμ up to the extreme red of the visible spectrum the results are given by

$$n^2 = 2\cdot51646 + 0\cdot0006709/(\lambda^2 - 0\cdot3205^2) + 0\cdot03900/(\lambda^2 - 0\cdot2262^2) - 0\cdot00030\lambda^2.$$

The paper is elaborately illustrated. W. H. Gr.

2334. *Diffraction of Light by Small Particles.* **H. Herbst.** (Zeits. Instrumentenk. 46. pp. 238–240, May, 1926.)—Deals with the diffraction of light by small particles and its bearing on the technique of the ultramicroscope. W. H. Gr.

2335. *Polarisation of Light emitted on Electronic Shock.* **F. Rasetti.** (Accad. Lincei, Atti, 3. pp. 484–489, April 18, 1926.)—Calculates out the polarisation of the radiation emitted by an oscillator excited by the passage, at a certain distance, of an electron of a given velocity, supposed constant. This does not meet the case where the electron loses practically all its kinetic energy, but it gives results of the order of those observed in mercury and sodium. A. D.

2336. *Polarisation of Light scattered by Some Organic Vapours.* **K. R. Ramanathan** and **N. G. Srinivasan.** (Indian Assoc. for Cultivation of Science, Proc. 9. pp. 203–209, June, 1926.)—In the paper by A. S. Ganesan [see Abstract 1857 (1925)] an approximate theory of the optical anisotropy of molecules was developed. More data were required regarding the polarisation of light scattered by vapours of substances whose molecular structures are otherwise known. Experimental data given and discussed; some points connected with the measurement of depolarisation in gases and vapours; the optical anisotropy of the carbon atom and its significance. A. D.

2337. *Magnetic Rotatory Polarisation in an Alternating Field.* **E. Persico.** (Accad. Lincei, Atti, 3. pp. 561–565, May 2, 1926.)—This mathematical paper shows that the value of the rotatory polarisation in an alternating field will not follow absolutely the instantaneous value of the field. In certain cases the effect of an alternating field will be greater than that of a steady field of the same magnitude. A. Wh.

2338. *Magnetic Rotatory Polarisation in an Alternating Field.* **E. Persico.** (Accad. Lincei, Atti, 3. pp. 603–607, May 18, 1926.)—Continued investigation into the relation between magnetic rotatory polarisation and the alternating field producing it. The analysis proceeds somewhat on the line of the usual treatment of anomalous dispersion, and the results are analogous. For frequencies removed considerably from absorption bands, the rotatory polarisation will be equivalent to that produced by a steady field of the same strength as the instantaneous value of the alternating field at the instant. In the region of an absorption band there will be two frequencies for which the rotation is infinite. These frequencies will be given by the sum and difference of the frequency of the absorbing oscillators and the frequency of the alternating field. A. Wh.

2339. *Effect of Salts on Rotatory Power.* **E. Darmois.** (Comptes Rendus, 182. pp. 1211–1214, May 17, 1926.)—Long, Schutt and others have noticed a small effect of alkaline salts (KCl, NaCl) on the rotatory power of tartrates, and de Mallemann has found larger effects for tartaric acid, malic acid and their ethers. The author has investigated other cases in which these acids are concerned—for example, the acid mixture $2MoO_3$, $C_4H_6O_5$, which forms definite salts; the rotatory power is greatly modified when it is dissolved in a salt solution. A table is given showing the values in water and KCl*n* for different concentrations. Other neutral salts were investigated, also mixtures of tartaric or malic acid with boric acid. The results can be explained by supposing that the acid complexes formed in solution are in equilibrium with uncombined active acid, and that this equilibrium is disturbed in a solution of neutral salt, which can be regarded as a solvent with thermodynamic properties which are quite different from those of water. The salts of the complex acids are also considered, and other theoretical deductions are made. H. N. A.

2340. *Coherence and Consonance of Light.* **M. Berek.** (Zeits. f. Physik, 37. 4–5. pp. 387–394, 1926.)—Continuation of research on the subject [Abstract 2067 (1926)]. The theory is worked out of interferences associated with refraction. A. D.

2341. *Fluctuation Theory of Scattering of Light in Gases.* **J. Kunz.** (Phil. Mag. 2. pp. 237–241, July, 1926.)—In a previous paper [see Abstract 1070 (1920)] the author has given an elementary theory of the scattering of light by small dielectric spheres. He now considers the scattering of light by the molecules of a gas due to fluctuations of the density of the gas from point to point, and shows that the theory of fluctuations can be reduced in part to the previous theory in which the Stokes-Thomson method was used for determining the radiation of an oscillating charge. The result derived is that the light scattered in a direction at right angles to the primary beam should be completely polarised, since the molecules have been regarded as spherical and isotropic particles. But it is well known that even in the case of gases the transversely scattered light is imperfectly polarised, and this is ascribed, in accord with Raman, to the anisotropy of the molecules with varying orientations. H. H. Ho.

2342. *Molecular Scattering of Light.* **K. C. Kar.** (Phys. Zeits. 27. pp. 380–381, June 1, 1926.)—Einstein's equation [Abstract 815 (1911)] fails at the critical point of a substance. Works out a new equation. A. D.

2343. *Scattering of Light by Aqueous Sodium Silicate Solutions.* **P. B. Ganguly.** (J. Phys. Chem. 30. pp. 706–712, May, 1926.)—The relative scattering power for white light of aqueous sodium silicate solutions of varying ratio of SiO_2 to Na_2O is determined with reference to a standard turbid medium, and is found to be very much greater than that of ordinary molecular solutions. A sudden increase of the rate of change of scattering power with increase of ratio is noted when the molar ratio 3 is exceeded. By means of a slit ultra-microscope the average number of visible particles per c.c. of such silicate solutions is determined, a rapid increase in this number being observed when the molar ratio 3 is exceeded. It is inferred that the sodium silicate solutions contain colloidal aggregates which increase in concentration or size (or both) with increase of the ratio of SiO_2 to Na_2O, the amount of colloidal matter present increasing rapidly with increase of this ratio beyond the molar ratio 3. A. B. C. L.

2344. *Scattering of Light by Sputtered Metallic Surfaces.* **L. A. Ramdas.** (Indian Assoc. for Cultivation of Science, Proc. 9. pp. 323–327, June, 1926.)—Experiments were made on metallic films of Au and Ag obtained by kathode sputtering on freshly cleaved surfaces of transparent mica. For low currents only the free surface was covered with crystals which could be detected with a microscope, while the mica-metal contact surface was found even with a high-power microscope to be absolutely structureless. The surfaces rapidly deteriorated unless kept free from air and dust. The intensity of the scattering of the gold-mica surface is the least hitherto obtained and only one-fifth that for a mercury surface. The remarkably high optical perfection of the mica-gold boundary indicates that the part of the film in actual contact with the mica surface does not consist of discrete crystalline aggregates of microscopic size, but is a more or less perfectly uniform structure of either individual atoms or of aggregates containing only a small number of atoms which have cohered into a uniform structure. [See also Abstract 286 (1926).] R. S. R.

2345. *Sensitiveness to Light of Organic Substances with Chromate.* **J. M. Eder.** (Zeits. f. Physik, 37. 4–5. pp. 235–237, 1926.)—Comments on work by J. Plotnikow and N. Karschulin on the extent of regions in which collodion films treated with bichromate and with bichromate and cresyl-blue 2BS are sensitive. Eder points out that the results obtained do not hold for the chromate-gelatine used in photography, since the regions of maximum sensitivity are different. A. C. M.

2346. *Sensitivity to White Light of Time-varying Intensity.* **E. Haas.** (Comptes Rendus, 182. pp. 1176–1178, May 10, 1926.)—Gives details of experimental arrangements and some results for work on the influence of the intensity of the initial illumination of a surface upon the perception of a variation of its illumination. W. H. Ge.

2347. *The Photographic Plate as an Instrument for the Measurement of Visible and Invisible Radiations.* **C. Fabry.** (Phot. J. 66. pp. 328–341; Disc., 341–342, July, 1926. Hurter and Driffield Memorial Lecture.)—This paper deals with applications in which photography is used to measure the intensity of radiations falling on the photographic plate along the following lines: Utility of the photographic method for the measurement of intensities; general principles of photographic photometry; conditions for the photographic measurement of intensity; influence of the properties of the plates; comparison between different radiations; some examples of the use of photographic photometry; measurement of a complex radiation as a whole. A. E. G.

2348. *The Arc as a Source of Light in Photometry with Photo-cells.* **B. Kurrelmeyer.** (Zeits. Instrumentenk. 46. pp. 321–322, June, 1926.)—Koch in his paper on the registration microphotometer [see Abstract 400 (1913)] has remarked on the lack of constancy of the electric arc light for photometric work, and the present paper records an attempt to remedy this defect by means of adjustable glass plates or plane half-mirrors whereby the changes of the comparison beams are made in the same ratio. [See Abstract 2083 (1926).] **H. H. Ho.**

2349. *Thiocarbamide Fog and Waterhouse Reversal.* **S. O. Rawling.** (British Phot. Research Assoc. Lab., Comm. No. 56. Phot. J. 66. pp. 343–350; Disc., 350–351, July, 1926.)—A theory based on consecutive reactions in accord with the known chemical properties of thiocarbamides in relation to the silver halides, together with the assumption that silver sulphide nuclei on the grains act as development centres provided they are sufficiently large. **A. D.**

2350. *Radiation in Intense Magnetic Fields.* **E. Fermi.** (Accad. Lincei, Atti, 3. pp. 478–483, April 18, 1926.)—Works out, on Bohr-correspondence and Fourier theorem lines, the intensities of those additional lines which appear in the spectrum of atoms when these are in an intense magnetic field. **A. D.**

2351. *The Light Emission of Solidified Gases and its Relation to Cosmic Processes.* **L. Vegard.** (Ann. d. Physik, 79. 5. pp. 377–441, March 24, 1926.)—A comprehensive account of the author's work on the light emission from solidified gases when bombarded with kathode and canal rays. A description, with diagrams, is included of low-temperature apparatus in which the bombardment is carried out. Some of the chief results are: (1) Solid nitrogen stimulated with slow kathode-rays emits a spectrum which agrees from red to ultra-violet with that of the Northern Lights. (2) For pure nitrogen two bands, N_1 and N_2, appear in a broadened form. It is shown from experiments on rare gases containing various quantities of nitrogen that the N_1 band takes the form of a line on using decreasing percentages of nitrogen. This effect is due partially to a specific action of the rare gas and partially to a decrease in the size of the nitrogen particles. The Northern Lights line appears therefore as the limit of the N_1 band as the "pseudogaseous" state of nitrogen is approached. (3) Excitation by canal-rays gives N_1 and N_2, but in the blue and violet a diffuse band series which does not appear in the Northern Lights. It is therefore concluded that the latter arise from electronic excitation. (4) Solid nitrogen exists in two modifications (α and β) with a transition temperature of 35·5° A. α nitrogen is much more active in its emissions. (5) The power of phosphorescence is limited to the α modification. (6) The phosphorescence is chiefly N_2, and is characteristic of the solid state. (7) Some fourteen bands observed are all to be ascribed to solid nitrogen (α). (8) The structure of these many and unusually long oscillation series arises from the possibilities of vibration of the nitrogen atom in the crystal lattice at low temperatures. **W. V. M.**

2352. *Visible Radiation of Negative Glow in Ne and He.* **C. Heinrich.** (Ann. d. Physik, 80. 4. pp. 349–366, June 22, 1926.)—A spectrophotometrical investigation into the distribution of energy and the variations of the intensity of the different lines with the current strength or density and the amount of electrical energy supplied. Detailed results. **A. D.**

2353. *Spark Spectra of Neon.* **L. Bloch, E. Bloch and G. Déjardin.** (J. de Physique et le Radium, 7. pp. 129–134, May, 1926.)—The spectra of NeII and NeIII have been excited in silica tubes with external electrodes, the lines emitted being controlled by the pressure of the gas. Tables of wave-lengths and intensities are given, supplementing those already published [see Abstracts 1652 (1925) and 1338 (1926)]. F. S.

2354. *Spontaneous Reversal of the Neon Lines.* **H. Buisson and C. Jausseran.** (Rev. d'Optique, 5. pp. 149–160, April, 1926.)—The article develops a former note [see Abstract 1388 (1925)], and shows that most of the red neon lines are reversed when a layer of gas some centimetres thick is observed. The spectrum of a Geissler's tube, with a capillary joining two bulbs, is examined by means of a Fabry-Perot interferometer combined with a spectroscope, which cause considerable dispersion of the lines; these are photographed, and the amount of blackening at different points in the breadth of each line is measured photometrically. When the light is emitted radially from the axis of the capillary the resulting curve shows a single maximum, while for many lines two maxima on either side of the position of the above maximum are observed when the light comes from the direction of the axis. A table gives the amount of this effect for a number of lines and the Paschen classification of each of these. Strong reversal is observed in those which are the first terms of the series S_5, S_4 and S_3. H. N. A.

2355. *Structure of the Argon Spectrum.* **K. W. Meissner.** (Zeits. f. Physik, 37. 3. pp. 238–242, 1926.)—The strong group lying in the far-red region of the "red" argon spectrum is shown to fit in with the term switches $1s_i - 2p_k$, and the resemblance is shown to the corresponding group in the neon spectrum. The resonance lines measured by Lyman and Saunders are fitted in with the scheme. This leads to the ground-term of argon having $j = 0$, which agrees with absorption measurements. [See Abstract 269 (1926).] A. C. M.

2356. *Infra-red Spectrum of a Diatomic Gas.* **E. C. Kemble and D. G. Bourgin.** (Nature, 117. p. 789, June 5, 1926.)—New measurements of the relative intensities of the lines in the $3 \cdot 5\,\mu$ band of HCl have been made to test the theoretical formula already given [see Abstract 726 (1926)]. Previous measurements had suggested that p should be given by $p = 2m + 1$, $m = 1/2, 3/2, 5/2$, etc., while later theory gives $p = 2m$, $m = 1/2, 3/2, 5/2$, etc. The new values confirm the latter expression within 4 %, and the work shows that the lines are much narrower and deeper than had been expected. F. S.

2357. *Visibility of First Part of Ultra-violet Spectrum.* **J. Saidman and L. G. Dufestel.** (Comptes Rendus, 182. pp. 1173–1175, May 10, 1926.)—Using a quartz monochromator of short focal length and large aperture (1/3) and a quartz mercury-vapour lamp, it is found that the region 3650 Å. is visible to the human eye placed in favourable conditions. The sensitivity in this region is of the order of one-millionth of that in the region of maximum sensitivity. The time of accommodation is of the order of several minutes in diffused light for satisfactory perception. Experiments with high-frequency sparks between metal electrodes have so far failed to give positive results. W. H. Ge.

2358. *Ultra-violet Absorption Spectra of the Rare Earths.* **J. H. Gardiner.** (Chem. Soc., J. pp. 1518–1522, June, 1926.)—The spectra were photographed with a quartz spectrograph with fixed slit, wavelengths being given by the spectrum of an alloy of Zn, Cd, Hg and Sn. The bands found in praseodymium, neodymium, samarium, europium and erbium are listed and the spectra reproduced. Lanthanum, ytterbium, gadolinium, terbium, thorium, cerium and scandium were also investigated but found to give no bands between 400 $\mu\mu$ and 350 $\mu\mu$. A 10 % solution of the nitrate in water was used in all cases. F. S.

2359. *Hydrogen Lines in Stars and in the Laboratory.* **E. O. Hulburt.** (Frank. Inst. J. 201. pp. 777–798, June, 1926.)—The state of reversal and broadening of hydrogen lines in various stars and in various laboratory sources are discussed, and the conditions for absorption of hydrogen lines made clear. A. C. M.

2360. *Fine Structure of Hydrogen Lines.* **A. H. Bucherer.** (Zeits. f. Physik, 37. 6. pp. 395–404, and 37. 10–11. p. 862, 1926.)—It is shown that the special theory of relativity is not applicable to the problem of the equations of motion of electrons. The mechanics founded on Hasenöhl's theorem are applied to the fine structure of hydrogen, and this leads to the value $\nabla\nu = 0\cdot296$ for the separation, in good agreement with the early measurement. It is fundamental in the theory that the same conditions hold in the circular motion of an electron around the nucleus as in a field-free space. A. C. M.

2361. *Structure in the Secondary Hydrogen Spectrum. Part IV.* **O. W. Richardson.** (Roy. Soc., Proc. 111. pp. 714–753, July 2, 1926.)—Fulcher's bands, as extended by himself and Allen [see Abstract 2768 (1924)], consisted of 6 sets of 5 lines in the red whose wave numbers obey a parabolic law very closely with also 4 sets of 4 lines in the green having similar properties, and their numerical coherence has been discussed by Curtis [see Abstract 1657 (1925)]. A more detailed examination of the spectrum of the first type discharge has now shown that there are a number of other lines which belong to the same system as Fulcher's bands. It is proposed to rearrange these lines so that S_3 to S_{-1} form a Q branch, S_4 the first line of an associated R branch to which there is a corresponding P branch, S_6 and S_5 the first 2 lines of an associated Q^2 branch, and S_7 the first line of an associated R′ branch to which there is a corresponding P′ branch. This holds throughout the first 5 of the 6 red bands. Four similar bands occur in the green and 5 in the blue, but the branches in those regions which would correspond to the dashed letters have not yet been located with certainty. There is a combination such that $R(m) - P(m + 1)$ has the same value for corresponding lines of corresponding bands in the red, the green and the blue. The quantum structure of the bands is not fully determined, but it is shown that they can be represented by terms of integral and semi-integral type. Reasons are given for believing that the emitter of this band system is the neutral hydrogen molecule H_2 formed and excited by the combination of the ionised molecule $H_2 +$ with an electron.

A further note by the author (Nature, 118. p. 116, July 24, 1926) records that the green and red bands have the same electron jump, but correspond to different sets of vibrational transitions. In addition, there are 5 other less well-developed sets of bands with the same electron jump, 2 in the infra-red and 3 on the violet side of the green. There is an intercombination between the lines of all the above bands, and indications of a further combination in the members of the PR branches, which, however, are less well developed than the Q branches. The blue bands have a different electron jump, and it appears that there are less well-developed bands on the violet side of these, which are connected with them and with the red bands by a Rydberg formula. The author opines the system to constitute the band analogue of Balmer's series. H. H. Ho.

2362. *Widening of the Balmer Lines by Absorption.* **(Miss) M. Hanot.** (Comptes Rendus, 182. pp. 1329–1331, May 31, 1926.)—Spectral lines can be widened by absorption in the source itself when a large number of luminous particles are in the line of sight. Gouy has investigated this in the case of coloured flames [see Abstract 1253 (1920)]. The case of H_β and H_γ has been investigated by photographing simultaneously two spectral images of the same spark, one only being subject to absorption in a second spark. It is concluded that there is absorption of approximately 30 % at the centre of each line due to the second spark. F. S.

2363. *Infra-red Absorption in Ethers, Esters, etc.* **A. W. Smith** and **C. E. Boord.** (Am. Chem. Soc., J. 48. pp. 1512–1520, June, 1926.)—The absorption spectra between 1 μ and 2·5 μ have been studied for a series of ethers, esters and related compounds. The positions of the absorption bands found in these compounds do not change appreciably with molecular structure. A decrease in the intensity of these absorption bands in such compounds as tetrachlor-ethane and trichloro-ethylene as compared with ethylene chloride and dichloro-ethylene respectively is probably due to the decrease in the number of hydrogen-carbon linkages in the molecule. These absorption bands are characteristic of the hydrogen-carbon linkages, and can be expressed approximately as a harmonic series. A. D.

2364. *Spectrum of Lightning.* **J. Dufay.** (Comptes Rendus, 182. pp. 1331–1333, May 31, 1926.)—The spectrum below 3850 Å. has been investigated by a quartz spectrograph of low dispersion, one flash usually sufficing to give a spectrum. A number of wide bands are listed and identified with known nitrogen bands. F. S.

2365. *Complex Structure of the Copper Spectrum.* **C. G. Bedreag.** (Comptes Rendus, 182. pp. 1333–1335, May 31, 1926.)—It is pointed out that from the law of variation of spectral multiplicity complex doublets and quartets are to be expected in the copper spectrum. Two examples of quartets are given at λ3483, 3512, 3545 and λ3621, 3635, 3645 respectively. These are discussed with relation to their departure from regularity in interval of the component lines. F. S.

2366. *Series Spectrum of Palladium.* **J. C. McLennan** and **H. G. Smith.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 157–176, Jan., 1926.)—The classification of this spectrum by Beals [see Abstract 97 (1926)] has been extended, use being also made of measurements of absorption by the vapour in the ultra-violet and Schumann regions. Tables are given of the terms of the arc spectrum, the lines identified in this spectrum and absorption lines already mentioned. F. S.

2367. *Under-water Spark Spectra of the Palladium-Platinum Group of Metals.* **L. H. G. Clark** and **E. Cohen.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 55–67, Jan., 1926.)—A method involving the use of an under-water spark has been used to study the spectra of ruthenium, rhodium, palladium, osmium, iridium and platinum. Tables of wave-lengths constitute most of the paper. W. V. M.

2368. *Zeeman-Effect in Palladium Spectrum.* **M. Lewitsky.** (Ann. d. Physik, 80. 4. pp. 397–407, June 22, 1926.)—Measurements were made of the transversal Zeeman-effect for the palladium spectrum [Abstract 1355 (1926)], the field strengths employed being from 36,000 to 40,000 gauss, and in a few cases 48,000 gauss. The results are presented in tabular form. The majority of the palladium lines give in the first order a triplet which often possesses abnormal intensity distribution. In higher orders it is seen that most of these triplets have a complex structure. They can be divided into apparently well-defined classes: (1) Sharp triplets, (2) moderately sharp triplets, and (3) diffuse triplets. The last two classes are usually complex in structure. Besides the triplets are two types of lines which in coarse structure are quadruplets. The first type consist of four well-defined lines, while the second type has two fairly sharp *p*-components and two diffuse lines for the *s*-components, which latter probably contain many fine lines. Only in a few cases could these fine lines be definitely observed and measured. Particulars are also given of seven lines with complex structure. A. W.

2369. *Zeeman-Effect in Ruthenium.* **L. A. Sommer.** (Zeits. f. Physik, 37. 1–2. pp. 1–34, 1926.)—The Zeeman-effect measurements show that RuI possesses odd multiplicity; triplets and quintets are found. The calculation of the *l*-values by comparing the observed and calculated *g*-values is only partly successful. The rule $\Delta l = 1$ or 3, 0 or 2 is confirmed. The ground-term is an inverse quintet F term. The empirical and theoretical terms are compared. The ionisation potential of Ru is about 7·5 volts. Conclusions are drawn from consideration of ^5F, ^3F, etc., as to the arrangement of the electrons in the atom in several elements in the first part of the long period to which this element belongs. Probable relationships are put forward between RuI and RuII. A. C. M.

2370. *Zeeman-Effect in Pb.* **E. Back.** (Zeits. f. Physik, 37. 3. pp. 193–209, 1926.)—The series analysis of the lead spectrum [see Abstract 1650 (1925)] is checked by the Zeeman-effect measurements. At the same time the empirical rules controlling the Zeeman-effect in multiplets of higher degree are made clearer. Rational *g*-values are given for the terms of the spectrum. A. C. M.

2371. *Electrodynamics of the Rotating Electron.* **J. Frenkel.** (Zeits. f. Physik, 37. 4–5. pp. 243–262, 1926.)—The author reviews briefly the theory of the rotating quantised electron advanced to explain the anomalous Zeeman-effect, by Uhlenbeck and Goudsmit and modified by Thomas. He then gives a general theory of the motion of a rotating electron in a given electromagnetic field, the electron being treated as a point with which is associated a six-vector (moment tensor) determining its magnetic properties. The explanation of the anomalous Zeeman-effect given by Thomas is established in a more rigorous fashion and amplified. The electromagnetic field of a rotating electron is determined, and it is indicated that the structure of the atomic nucleus will be conditioned chiefly by magnetic forces between electrons and protons. W. S. S.

2372. *Application of Quantum Mechanics to the Anomalous Zeeman-Effect.* **W. Heisenberg** and **P. Jordan.** (Zeits. f. Physik, 37. 4–5. pp. 263–277, 1926.)—The authors consider a rotating electron describing an orbit about a heavy positive nucleus in the presence of an external magnetic field. The Hamiltonian function of the system (determined by ordinary mechanical principles) will include terms arising from (1) the magnetic interaction of the external field with the rotating and encircling electron, (2) the magnetic interaction of the nucleus and the electron, (3) the relativity change of mass with velocity. These terms are evaluated, and it is then assumed that in the new quantum mechanics they will have the same form as is given by classical mechanics and electrodynamics. The new methods are employed to calculate the frequencies of the system, and the results obtained show complete agreement with the observed anomalous Zeeman-effect. In the absence of the external field, the correct fine structure of the doublet spectra is established. The paper is mathematical. W. S. S.

2373. *The Arc Spectrum of Copper at Low Pressures.* **G. Wolfsohn.** (Ann. d. Physik, 80. 4. pp. 415–435, June 22, 1926.)—Explains the advantage of using a vacuum arc from the theoretical point of view and in determining standard wave-lengths. Describes the vacuum arc employed and the method of comparing the photographs obtained with the standard lines of iron and with the copper arc at air-pressure. The arc spectrum of copper was in both cases measured in the region λ2100–5200, and the shift in a number of lines due to pressure was determined and investigated. The results obtained were applied to the classification of the arc lines and the system of standard wave-lengths. The results are given in a series of tables. H. N. A.

2374. *Light Stimulation in Zn Vapour.* **N. Ponomarew** and **A. Terenin.** (Zeits. f. Physik, 37. 1–2. pp. 95–97, 1926.)—Continuation of an earlier investigation [see Abstract 1362 (1925)]. In zinc vapour of $5 \cdot 10^{-4}$ mm. (280° C.) pressure emission of lines 3076 ($1S \longleftrightarrow 2p_2$) and 2139 ($1S \longleftrightarrow 2P$) is caused by radiation from a Zn vacuum arc. A. D.

2375. *Light Stimulation of Atoms and Molecules by Radiation.* **A. Terenin.** (Zeits. f. Physik, 37. 1–2. pp. 98–125, 1926.)—I. Antimony and arsenic. The vapour of Sb, dissociated at 1100° C., and radiated upon by an arc in antimony vapour. The light excited was examined spectroscopically, and from the relations between the exciting and the excited lines conclusions were drawn as to the levels-scheme of antimony. With arsenic, on account of imperfect dissociation, only the line 2288 was found. II. Thallium fluorescence. The emission of line 5351 ($2p_1 - 2s$) on stimulation with 3776 ($2p_2 - 2s$) and at the same time with 5351 is only due to absorption of 3776, and there is no observable stimulation of thallium

atoms in the metastable condition $2p_1$ by the line 5351. III. Mercury. Observations on the optical stimulation of mercury atoms in the $2p_2$ condition. IV. Optical stimulation of NaI vapour. NaI vapour of 10^{-3} to 10^{-1} mm. pressure (450° to 600° C.), radiated upon by lines of less wave-length than 2500 Å., emits D lines and under certain circumstances also 3302–3 lines. This is provisionally explained as being due to a break-up of the NaI molecule into atoms, of which the Na atom is stimulated.
A. D.

2376. *New Lines* ($1S - 2p_{1, 3}$) *of Zinc Cadmium and Mercury.* **M. Fukuda.** (Inst. Phys. and Chem. Research, Tôkyô, Sci. Papers, No. 55. pp. 171–175, March, 1926. In English.)—The mercury line λ2656 Å. ($1S - 2p_3$) was obtained in the narrow part of a conical capillary tube using a condensed discharge. It was also excited with considerable intensity by a heavy condensed discharge in a Geissler tube with a narrow capillary of about the same diameter as that of the portion of the conical capillary where it was previously obtained. The $1S - 2p_1$ lines for Cd (λ3141 Å.) and Zn (λ3040 Å.) and the $1S - 2p_3$ line for Cd (λ3320 Å.) were observed in the end on emission of tubes with a heavy condensed discharge. $1S - 2p_1$ for Cd and $1S - 2p_3$ for Zn were observed in the heavy current vacuum arc, about 120 amps./cm.^{2} being needed for the first and 200 amps./cm.^{2} for the second. H. N. A.

2377. *The Change of the Wave-Length of the Cadmium Red Line* (λ6438·7 Å.). **M. Fukuda.** (Inst. Phys. and Chem. Research, Tôkyô, Sci. Papers, No. 54. pp. 167–169, March, 1926. In English.)—An interferometer invented by H. Nagaoka, the interferential prism, which gives very bright fringes with a moderately intense light source, was mounted on a Zeiss "Licht-Stark" spectrograph and used to photograph side by side the fringes produced by the above cadmium line with and without a self-inductance of 8×10^{-4} henrys in the discharge circuit. The amount of change in the wave-length was found to be $- 0 \cdot 044$ Å., the minus sign indicating that the wave-length was shifted towards the red when the self-inductance was removed. This shift will not be of much influence in the evaluation of standards of length. H. N. A.

2378. *Continuous Spectrum of Mercury-Vapour.* **Rayleigh.** (Roy. Soc., Proc. 111. pp. 456–461, July 2, 1926.)—Gives a reproduction of a photograph of the mercury spectrum, consisting of a line spectrum with a continuous spectrum which extends from the neighbourhood of the resonance line 2536·52 $1S - p_2$ to the green, and even into the red. There is a sharp high maximum near 2536, another rise of intensity at 3340, and a third at 4550. When the continuous spectrum is produced without the resonance line, by Wood's method of fluorescent excitation with the aluminium spark, it is seen to end abruptly at 2535·9; the resonance line and the band at 2540 appear reversed on the continuous background. The continuous spectrum was also obtained by absorption, and the measured limit was here found to be 2535·5. It is probable that with a diminished quantity of absorbing vapour the limit would be at the same position as in the emission spectrum. H. N. A.

2379. *Spectra of Metals under Heavy Current Excitation.* **M. Fukuda, T. Kuyama and Y. Uchida.** (Inst. Phys. and Chem. Research, Tôkyô, Sci. Papers, No. 56. pp. 177–188, April, 1926. In English.)—A number of lines forbidden by the selection rule have previously been observed in a constricted arc [see Abstract 125 (1925)]. The present work is an extension of this to higher current densities up to 200 amps. per cm.^{2}. A new form of arc lamp with Wehnelt kathode is described for production of these spectra, which were photographed with a quartz spectrograph. Tables of wave-lengths of the forbidden lines of zinc and cadmium are given, higher members of the PD series having been observed. Some of the lines of $1S = p_i (i = 1, 2, 3)$, which are prohibited by the inner quantum conditions, were observed. A table is also given of the sequences of "*b*," "*e*" and "*f*" energy levels, together with a note on the prime termed lines of cadmium. F. S.

2380. *λ4722 of Bismuth and the Nature of "Raies Ultimes."* **A. L. Narayan** and **K. R. Rao.** (Phys. Soc., Proc. 38. pp. 321–323, June, 1926.)—Following the previous experiments of one of the authors on the nature of the green line λ5350 of thallium, a detailed examination of λ4722 of bismuth was made with a quartz Lummer plate, and it has been found that there is not even the slightest trace of absorption in the main component or in the satellites, even at 1000° C. The fluorescence of the vapour under optical stimulation was studied, and it was found that when excited by radiation of wave-length from λ6000 to 3500 the fluorescence was a banded spectrum in the orange-yellow, while when excited by ultraviolet radiation from a bismuth arc the fluorescence was bluish, and consisted of λλ4722 and 3068, thereby showing that λ3068 represents the minimum excitation energy and corresponds to transition to the normal orbit. AUTHORS.

2381. *Energy Levels of the Carbon Monoxide Molecule.* **O. S. Duffendack** and **G. W. Fox.** (Nature, 118. pp. 12–13, July 3, 1926.)—Johnson has shown the relation of the third positive carbon bands to the Cameron bands [see Abstract 1341 (1926)] and that the final states of the latter are identical with those of the fourth positive carbon bands, shown by Leifson [see Abstract 1583 (1926)] to be due to the neutral carbon monoxide molecule. Evidence in support of Johnson's view is advanced by the authors, who have found two sets of bands appearing at 10·2 and 11·1 volts respectively. The third positive bands were not obtained in purified CO_2 unless considerable voltage was applied, but appeared at much lower voltage in stagnant gas, when dissociation could take place. Carbon monoxide is thought to be unique in possessing two parallel sets of electronic energy levels. F. S.

2382. *Quantitative Spectral Analysis.* **S. Timpanaro.** (N. Cimento, 3. pp. 169–176, April, 1926.)—Traces the methods employed from Janssen (1869) to the present time, and gives methods for the determination of boron and of lithium. A. D.

2383. *Molecular Spectrum of Carbon Dioxide.* **J. W. Ellis.** (Nature, 118. pp. 82–83, July 17, 1926.)—Bjerrum and Dennison [see Abstract 1031 (1926)] have proposed a triangular molecule with apex angle of 145°. Dennison finds difficulty in predicting the 2·73 μ band, which he predicts should have intensity of only 1/180 of that of the two longer bands, whereas the ratio is actually 1/4. The author accounts for this band and also for the band he has found at 2·02 μ as combinations of the two strong bands. Their frequencies can be expressed as $\nu'_a + 2\nu_a$ and $\nu'_a + 4\nu_a$ respectively, where ν'_a and ν_a are the frequencies of the 4·25 μ and 14·66 μ bands. The differences of the observed and calculated frequencies are discussed. F. S.

2384. *Distribution of Intensity in a Positive Ray Spectral Line.* **M. C. Johnson.** (Phys. Soc., Proc. 38. pp. 324–333; Disc., 333–334, June, 1926.)—In studying the intensity distribution in a spectral line emitted by positive rays, a line structure was found which is not familiar in ordinary discharge-tube spectra. This structure would not appear under the low resolving powers necessitated by the extreme faintness of the light emitted in most investigations of Stark- and Doppler-effects in positive rays. The technique required to make possible the study of structure in such faint lines is discussed in detail. The explanation of the structure in terms of Doppler and Stark components is compared with the theory of broadened lines in ordinary discharge-tube spectra. AUTHOR.

2385. *Electron Levels in Certain Band Spectra.* **R. Mecke.** (Zeits. f. Physik, 36. 9–10. pp. 795–802, 1926.)—Term separations are compared in band spectra with those in the line-spectra of neighbouring elements. ZnH, ChH, HgH are like Cu, Ag and Au; the ground terms are estimated at 50,000 to 55,000. Term separations in HO, BO, C^+O and NO are practically all 126 cm.$^{-1}$, and are most comparable with the term separation in the N atom; the terms are estimated at about 125,000. This equality of separation is attributed to the possession by each molecule of an electron pursuing the same orbit in the oxygen atom. This allows conclusions to be drawn about the arrangement of electrons in the molecule. A. C. M.

2386. *Width and Pressure-widening of Spectral Lines.* **R. Minkowski.** (Zeits. f. Physik, 36. 11–12. pp. 839–858, 1926.)—At a sufficiently great distance from the middle of an absorption line the absorption-coefficient is not dependent on the Doppler-effect. By measuring the absorption at some distance from the middle of a line the natural width and the pressure-widening (for small pressures) can be investigated. The natural half-width of the sodium D lines is found to be 0·62 sec.$^{-1}$ in each case. After a pressure of 10^{-2} mm. of pure sodium vapour has been reached pressure-widening becomes noticeable; the magnitude of the pressure points to a particularly great mutual perturbation of the atoms. A. C. M.

2387. *Absorption Spectrum of CO_2.* **C. Schaefer** and **B. Philipps.** (Zeits. f. Physik, 36. 9–10. pp. 641–656, 1926.)—Some earlier work is produced as additional material in support of Dennison's suggested CO_2 molecular structure [see Abstract 1031 (1926)]. Some new bands are reported, and are shown to fit in; the atoms C, O, O must be arranged triangularly. The moments of inertia and the dimensions of the molecule are given. A. C. M.

2388. *Infra-red Absorption Spectra of Cellulose.* **R. O. Herzog** and **G. Laski.** (Zeits. phys. Chem. 121. pp. 136–142, May 23, 1926.)—Measurements in the fluorite dispersion region, intended to be part of a series of long wave-length measurements on cellulose, in order to find out what oscillations very large molecules undergo. Films of cellulose and intro-cellulose were used, one film of each being mercerised. Absorption bands are found at 2·9 μ and 6·0 μ, regarded as the fundamental and octave due to the hydroxyl groups. At 3·35 μ is a sharp absorption frequency and a strong absorption at 7 μ. These are attributed to the CH_2 groups. A relatively weak absorption occurs at 4·6 μ in the cellulose only, and this is taken as characteristic of the CO binding. In the nitro-cellulose appears NO_3 absorption between 7 μ and 8 μ. Mercerisation caused slight changes in the absorption curves, showing that the process modifies the frequencies, and hence that a chemical change is implied. A. C. M.

2389. *Absorption Spectra of Te, Bi, Cr and Cu.* **R. V. Zumstein.** (Phys. Rev. 27. pp. 562–567, May, 1926.)—A hot carbon tube was used to investigate the absorption by vapours of these metals between 6000 and 2000 Å. The tellurium was heated in an iron side-tube at about 500° C., while the temperature of the carbon tube was about 1600° C. in the hottest part. A stream of N_2 flowed through the tube [see Abstract 743 (1926)]. The same procedure was used for bismuth; the chromium and copper were put direct into the tube. Four absorption lines were found from the atoms of Te, and two new arc lines were measured. Eight Bi lines were absorbed, four being new; and they are the lines to be expected from the work of Ruark, Foote, Mohler, and Chenault. Four new lines were measured in the spectrum of a 75-amp. arc. Three triplets were absorbed in chromium. Nineteen copper lines were absorbed, ten from the normal state, in agreement with Shenstone and McLennan and McLay, the other nine being from excited states. A. C. M.

2390. *Photometric Measurements of the L Absorption Limits of Tungsten.* **C. B. Crofutt.** (Phys. Rev. 27. pp. 538–541, May, 1926.)—By means of a photomicrograph camera consisting essentially of a lens system giving a narrow beam of light (0·06 mm.), which passes through a photographic plate and falls upon one junction of a thermocouple connected to a sensitive galvanometer, the deflection obtained is a measure of the transparency of the plate. This was utilised for the further analysis of the plates obtained by photographing the absorption and emission spectra of tungsten simultaneously on the same plate. The results [Abstract 2279 (1924)] then given are now revised, and it is found they give values for L_1 1·2117 Å. and for L_2 1·0708 Å., as compared with eye measurements of 1·2122 Å. and 1·0716 Å. respectively. The author considers the latter to be more reliable. L_1 is clearly between β_5 and β_{10}, whilst L_2 is between γ_6 and γ_2, or actually between γ_6 and a new line 1·0699 Å. The mean variation in the measurements is less than 0·0002 Å. S. G. B.

2391. *Irregularity of the Kα Doublets in the Elements of Lower Atomic Numbers.* **D. M. Bose.** (Phys. Rev. 27. pp. 521–529, May, 1926.)—From the measurements of the separation (Δλ) of the Kα doublets of the lighter elements (Al [13] to Ge [32]) by Siegbahn, Roy and Bäcklin it appears that the experimental values of $\Delta\nu/R(Z - 3{\cdot}5)^4$ deviate systematically from Sommerfeld's values obtained from relativity formulæ, and the deviation is large of the Fe group of elements. The deviation is explained by assuming $\Delta\nu/R = \Delta\nu_{\text{rel.}}/R + \Delta\nu_{\text{mag.}}/R$, where the first term is due to the relativity mass charge of the radiating electron in the two orbits producing the relativity doublet K, and the second term expresses the difference in the magnetic energy of the excited atom corresponding to the two different K_2 values of the radiating electron. Landé's model for the relativity doublet on a magnetic basis was used to calculate the second term. It is shown that if K_2 determines the shape of the electron orbit, then $\Delta\nu_{\text{mag}}/R(Z - 3\cdot 5)^3 = \frac{3\alpha^2}{32}$, and the mean of the experimentally calculated values agrees better than otherwise. It is also shown that the idea set forth in a previous paper for the behaviour of Kα doublets of the first transition group of elements receives further support in this paper. S. G. B.

2392. *K Emission Spectra for Elements Tin to Hafnium.* **J. M. Cork and B. R. Stephenson,** (Phys. Rev. 27. pp. 530–537, May, 1926.)—A continuation of work with an X-ray tube previously published [see Abstract 1362 (1926)]. Measurements are recorded of the K sines emission wave-lengths of elements from tin (50) to hafnium (72) with the exception of xenon (54) and Ho (67). The β line is resolved into the components β′ and β with a wave-length difference of 0·76 *x*-units. The wave-length difference for α′ and α lines is from 4·4 *x*-units for tin to 4·84 *x*-units for hafnium. Slight irregularities are noted for groups of points if the doublet difference is plotted against atomic number. This may bear a relation to the addition of electrons in the process of atom-building.
S. G. B.

2393. *X-Ray Reflection at Low Temperature.* **E. Nies.** (Ann. d. Physik, 79. 8. pp. 673–694, May 4, 1926.)—The effect of temperature has been investigated by other workers at temperatures above normal [see Abstract 1661 (1925)]. Here the reflection is examined from calcspar at low temperatures, using an ionisation chamber and electrometer method. It is found that the reflecting-power for CuKα radiation in the first order increases by 2·0 ± 0·4 % when the crystal is cooled to liquid-air temperatures. This result is compared with what would be expected from the Debye theory. A. C. M.

2394. *Contribution to the Measurement of X-Ray Wave-lengths.* **J. Schrör.** (Ann. d. Physik, 80. 3. pp. 297–304, June 2, 1926.)—A continuation of previous work by Vogel, Weber and Lang [see Abstract 366 (1925)] on X-ray standards, consisting of precision measurements made by the Seemann method on the K and L series of some twenty-five elements. The measurements are made relatively to the CuKα, which is particularly suitable in that it falls in the region of wave-lengths investigated, results being obtained from chromium to rhodium in the K series and samarium to uranium in the L series. The accuracy claimed is of the order of 0·03 X-unit. In the L series a constant difference of 0·54 X-units exists between the results obtained and those due to Siegbahn, and the cause of this deviation is not entirely clear, various sources of error, such as dissymmetry of the lines, not being regarded as sufficient. Tables of wave-lengths are given. W. V. M.

2395. *Higher Order X-Ray Reflections from Fatty Acids.* **J. A. Prins and D. Coster.** (Nature, 118. pp. 83–84, July, 1926.)—Flaky crystals of lauric, palmitic and stearic acids were obtained by crystallising from acetone and mounted on the calcite crystal of the X-ray spectrograph. As found by Müller and Shearer, the odd orders from the long spacings are much more intense than the even orders. Unusually strong orders were, however, found at about the 12–14th, 16th and 18–20th in the three acids respectively. This is explained from a model of two molecules placed end to end in opposite directions. Further, the 34th order of palmitic acid and the 26th of lauric were obtained when the 28th and 21st respectively could not be observed. F. S.

2396. *X-Ray Term Values, Absorption Limits, and Critical Potentials.* **E. C. Stoner.** (Phil. Mag. 2. pp. 97–113, July, 1926.)—The elements titanium (22) to zinc (30) are mainly considered, and a table is given with the term values computed from the X-ray data; these are shown to fit in with those of elements of higher and lower atomic number. Deals with the fine structure of X-ray absorption edges. The term values involved seem to correspond to the energy required to remove an electron to the lowermost possible unoccupied optical level in the atom; this differs by only a few volts from that required to remove it to the boundary in the case of a neutral atom. The difference increases as the atom becomes more and more ionised. The fine structure observed for compounds appears to agree with the results of the above view, the order of magnitude of the separations between the components of the structure being accounted for. Critical potential results are compared together, some of the interpretations being criticised. It is suggested that some of the critical points are due to atoms which have been ionised by the loss of outer or inner electrons. Critical potential measurements are not suitable for precise determinations of atomic level-energy values. H. N. A.

2397. *Excitation of X-Rays.* **C. Gerthsen.** (Zeits. f. Physik, 36. 7. pp. 540–547, 1926.)—From a consideration of various experimental results it is concluded that the excitation by positive rays is governed by the law of conservation of energy. W. H. Gr.

RADIO-ACTIVITY.

2398. *Application of the Compton Theory to the β and γ-Radiations of Radio-Active Substances.* **(Mme.) P. Curie.** (J. de Physique et le Radium, 7. pp. 97–108, April, 1926.)—Considers the applicability of Compton's theory to a monochromatic group of γ-rays, emitted by a radio-active element, and diffused either by the electrons in the outer rings of the emitting atoms or in those of the surrounding atoms, the diffusion being accompanied by the emission of "recoil" or "shock" electrons. The division of energy between the diffused γ-rays and the shock electrons is considered, and also the wave-lengths of the γ-rays and the velocities of the β-rays. The formulæ and curves obtained are used in the discussion of the results arrived at by different observers in the study of the primary and secondary γ and β-radiation of the radio-elements; but it is pointed out that the actual behaviour of any element may be very complicated, since there are often several groups of monochromatic γ-rays, and the continuous spectrum due to the Compton-effect may be superposed on another continuous spectrum which is independent of this effect. In RaE there are practically no lines in the magnetic spectrum of the β-rays, due to photoelectrons from the inner electron shells, and the distribution of intensity in the continuous spectrum does not agree with that expected from Compton's theory. The energy of the γ-rays should, according to the theory, be greater than that of the β-rays, but, as a matter of fact, scarcely any are present. H. N. A.

2399. *Distribution of Radio-Active Materials in the Atmosphere.* **W. Schmidt.** (Phys. Zeits. 27. pp. 371–378, June 1, 1926.)—The author has discussed this problem in previous papers, and he now gives the results of a new calculation, based on the latest knowledge of the laws of irregular movements in the atmosphere, giving the distribution in altitude to be expected for the different emanations given off from the earth's surface and their disintegration products. The diminution of the quantities upwards is much more rapid than that deduced from the previous calculations. The following table shows the heights at which the amount is one-half, and in the last column one-tenth, of that at 1 m. above the surface:—

RaEm and its short-lived products ..	13 m.	150 m.
ThEm and ThA	1·15	1·6
ThB and its products	5·8	32
AcEm and AcA	1·07	1·2
AcB and its products	2·2	6·0

RaD and its products are distributed fairly uniformly in altitude. The result for RaEm agrees well with observations made in aeroplanes. The accepted values for the total amount of emanation in the atmosphere require correction. H. N. A.

2400. *Measurement of Radium during Radio-Active Growth.* **A. F. Dufton.** (Brit. J. of Radiology, 22. pp. 128–129, July, 1926.)—Illustrates a nomogram for computing the gamma-ray activity of a radio-active preparation with respect to time. B. J. L.

2401. *Obliquity Corrections in Radium Estimation.* **I. Backhurst.** (Phys. Soc., Proc. 38. pp. 277–289; Disc., 289–290, June, 1926.)—Formulæ are given for obliquity corrections in radium estimation applicable to sources of the shapes most frequently occurring in practice. The effect of scattered radiation is considered, and some experimental results are shown graphically and compared with theory. Calculated values for a particular case are given by way of example. AUTHOR.

HEAT.

2402. *Measurement of Conductivity of Gases by Schleiermacher's Method.* **H. Busch.** (Ann. d. Physik, 80. 1. pp. 33–42, May 18, 1926.)—Recently Schneider [see Abstract 1852 (1926)] carried out some measurements by the method of Schleiermacher and obtained values for air and hydrogen which differ considerably from those of Weber, who developed the method into one of considerable precision, but whose assumptions in obtaining the correction for the potential leads to the current-carrying wire seem rather arbitrary. The author calculates corrections for these leads which are based on more probable assumptions, and obtains values for the corrections which are of the same order of magnitude as those found by Weber, and hence considers the values of the conductivities as found by Weber to have more weight than those obtained by Schneider. In calculating the correction, the author assumes that the loss of heat from the potential wires is proportional to the difference in temperature between the wire and the gas surrounding it, and not proportional to the difference between the wire and the containing vessel as was assumed by Weber.
T. B.

2403. *Thermal Conductivity of Air and Hydrogen.* **E. Schneider.** (Ann. d. Physik, 80. 2. pp. 215–216, May 27, 1926.)—This gives correction in numerical values which were tabulated in the author's paper [see Abstract 1852 (1926)].
T. B.

2404. *Temperature Time Curves for Crystallisation of Glass.* **E. Zschimmer** and **A. Dietzel.** (Zeits. techn. Physik, 7. 6. pp. 278–282, 1926.)—A method is described for the accurate determination of the temperature time curves and point of crystallisation of a glass such as plate glass. The dependence of the crystallisation velocity on temperature and on the rate of change of temperature are determined for crystals of $10\,\mu$, $50\,\mu$, and $100\,\mu$ for plate glass.
F. S. B.

2405. *Specific Heat and Entropy of HCl.* **H. C. Hicks** and **A. C. G. Mitchell.** (Am. Chem. Soc., J. 48. pp. 1520–1527, June, 1926.)—Computation of the rotational-oscillational specific heat and entropy of HCl, using directly the actual experimental energy-levels for the different states of rotation and oscillation, which can be calculated from the interpretation of the absorption spectrum of HCl in the near infra-red. The theory of half-quantum numbers is used to determine the *à priori* probabilities of the different states. Results in good agreement with the experimental values.
A. D.

2406. *Latent Heat of Vaporisation and its Relation to Curvature and to Pressure.* **J. Satterly.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 229–231, Jan., 1926.)—Considering a capillary tube in water under an exhausted bell-jar it is shown that Houllevigue's equation $L' - L = (\omega/\sigma)(\log \omega/\omega')$ may be written $L' - L = (1/\rho)(\omega - \omega' + 2T/r) = gh$ very nearly, where L = latent heat of vaporisation over flat surface; L' that over concave; ω and ω' = vapour-pressures; ρ = density of liquid; T = surface-

tension of liquid; h = height of liquid in tube. It is also shown that the equation follows simply from a consideration of the potential energy. H. L. Callender [see Abstract 1720 (1908)] obtains an equation which reduces to $dL = (1/\rho)dP$, which is the same as that above but with reversed sign.
T. B.

2407. *Vapour-pressure Lowering as a Function of the Degree of Saturation. II.* **I. Bencowitz** and **H. T. Hotchkiss, Jr.** (J. Phys. Chem. 30. pp. 643–657, May, 1926.)—Further experimental evidence is adduced in support of two generalisations which are directly deducible from an equation developed in a previous paper [see Abstract 792 (1926)]. A. B. C. L.

2408. *Investigations on the Mixing Heats of Fused Metals.* **A. Magnus** and **M. Mannheimer.** (Zeits. phys. Chem. 121. pp. 267–288, June 10, 1926.)—Two methods are first described with full experimental details for the measurement of the mixing heats of fused metals, and their utility is demonstrated by several examples: Pb–Sn, Pb–Cd, Sn–Cd, Sn–Bi, Zn–Sn. The maximum heat of admixture for binary alloys was not established in any of the cases investigated of equimolecular mixtures. A cooling effect was found for the mixtures Pb–Sn, Sn–Cd, Pb–Cd, and Zn–Sn, whereas Bi–Sn exhibited a heating effect. With the mixture 75 % Zn and 25 % Sn an example was found for which the temperature lowering during adiabatic admixture of the two metals was greater than the depression of melting-point experienced by the higher melting component. H. H. Ho.

2409. *Quantum Statistics of Space Radiation and their Interchangeability with those affecting Material Bodies.* **A. Smekal.** (Zeits. f. Physik, 37. 4–5. pp. 319–341, 1926.)—An attempt to establish the quantum statistics of space radiation from observed facts, namely from the elementary radiation process of material bodies. It is shown that the theoretical light quantum deduction concerning the vibrations in space due to Bose can be developed independently from the theoretical light quantum conclusions obtained from the consideration of the quantum statistics of molecular translation. Planck's law of radiation and Einstein's work on the subject are deduced in this manner. The paper is entirely theoretical. S. G. B.

2410. *Heat Transmission by Irradiation.* **U. Bordoni.** (Accad. Lincei, Atti 3. pp. 554–560, May 2, 1926.)—In a mathematical disquisition following on a recent paper [see Abstract 1607 (1926)] the author critically examines the various formulæ that have been used for calculating the transmission of radiant heat from a body to its surroundings—that is to say, the difference between the radiation emitted and that simultaneously absorbed, for which difference he prefers the term "apparent emission."
E. F.

2411. *Extinction of Methane Flames by Diluent Gases.* **H. F. Coward** and **F. J. Hartwell.** (Chem. Soc., J. pp. 1522–1532, June, 1926.)—Determinations of the limits of inflammability of methane in atmospheres composed of air mixed with (1) carbon dioxide, (2) nitrogen, (3) argon and (4) helium show that the factors mainly responsible for the extinction of flame are the reduction of the oxygen content by the diluent gas, and also the thermal capacity and thermal conductivity of such gas. Exact treatment of the subject thus involves the thermal conductivities of certain gaseous mixtures up to 1000° or 1500°, which are unknown. The thermal capacity effect of the diluent is marked in the case of argon; the lower limit of methane is reduced from 5·24 % in air to 4·40 % in an atmosphere containing 47 % of argon and 53 % of air, and to 3·95 % in argon mixed with just sufficient oxygen to burn the methane completely. The thermal conductivity effect is marked when a comparison is made between the limits in atmospheres of air to which has been added argon on the one hand or helium on the other. The "limits generalisation" of Payman [Abstracts 460, 461 (1919); 731 (1920)] holds fairly accurately over the whole range of mixtures investigated, except near the point at which the lower and higher mixtures meet. Of all mixtures of methane and oxygen, that represented by $CH_4 + 2O_2$ is the last to become non-inflammable as inert gases (nitrogen, either alone or mixed with carbon dioxide, argon, or helium) are added in increasing amount. A parallel is observable between the "lags" on ignition and the dilution limits of the mixtures used, and these appear to be dependent on the same factors, in the case of any one inflammable gas. T. H. P.

2412. *Deductions from Various Forms of the Reciprocal Theorem.* **W. Jazyna.** (Zeits. f. Physik, 37. 4–5. pp. 304–307, 1926.)—On the basis of the various forms of the reciprocal theorem and of the "condition of existence" resulting therefrom, explanations are given concerning (1) the properties of van der Waals' equation of state, (2) Jakob's method, (3) dissociation of gas mixtures without altering the number of molecules, (4) unattainability of absolute zero, it not being a physical reality. [See Abstracts 1149, 1150 (1925).] E. F.

2413. *Energy Levels of the Ideal Monatomic Gas Model.* **E. Schrödinger.** (Preuss. Akad. Wiss. Berlin, Ber. 2–3. pp. 23–36, 1926.)—This paper commences with a discussion of the quasi-ergoden hypothesis and conditioned periodic systems. Previously the author [see Abstract 127 (1926)] had expressed the opinion that the Planck standpoint could not be maintained without arbitrary assumptions, *viz.* when quantification of the single molecule is not considered but quantum conditions are proposed for the gas as a whole. The author now quotes and investigates a proposal of Einstein, which is almost free from special assumptions, and refers to the Planck fundamental assumption that N ! states of the gas occur with energy levels U_n at a constant distance apart in the phase volume of $N!\,h^{3N}$. By making the lowest energy level, $U_0 = 0$, the whole thermodynamic behaviour may be evaluated. The calculation of the free energy from this new standpoint is dealt with. The case where the energyless state is excluded ($g_0 = 0$) is considered, and the pressure and energy for this case are evaluated. The inclusion of the energyless state ($g_0 = g$) is examined, and a physical interpretation is proposed for the mathematical results obtained by making a suitable extrapolation of the classical gas laws into the region of lowest temperature. H. H. Ho.

SOUND.

2414. *Velocity of Sound in Liquids.* **J. Satterly.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 133–137, Jan., 1926.)—A note dealing with the relation between the latent heat of vaporization of and the velocity of sound in a liquid. The Lewis formula is criticised, and is shown to fail for water. A correct formula has not yet been found. W. H. Ge.

2415. *Mutually Counteracting Pinhole Probes.* **C. Barus.** (Nat. Acad. Sci., Proc. 12. pp. 223–227, April, 1926.)—An extension of the work described in an earlier paper [see Abstract 138 (1926)]. G. A. S.

2416. *Acoustic Transmission in a Conduit with a Branch Line.* **G. W. Stewart.** (Phys. Rev. 27. pp. 487–493, and 494–498, April, 1926.)—The author's theory of acoustic transmission in a conduit with a branch line is extended to the cases when the branch is (*a*) a Helmholtz resonator, (*b*) an orifice, (*c*) an open tube, (*d*) a closed tube, (*e*) an impedance of any kind. Experimental verification is obtained. The action of orifices in musical instruments is explained by this theory. G. A. S.

2417. *Optimum Reverberation.* **S. Lifshitz.** (Phys. Rev. 27. pp. 618–621, May, 1926.)—The optimum time (T) of reverberation was determined experimentally for player-piano, violin, violoncello, bass and soprano voices and for human speech in the concert hall of the State Institute of Musical Science in Moscow, which has a volume of $265m^3$ and reverberation when empty of 2·63 sec. The values (1·08 – 1·14) give a mean of 1·11 sec. as compared with an earlier investigation in a hall of volume $126m^3$, which gave $T = 1 \cdot 06$ sec. It is deduced that a mean intensity of sound exists which is the same for human speech and musical performance of different kinds, with respect to which our ear determines the optimum of the impression. This intensity (10^{6n} times minimum audible intensity i) is given by: $1 \cdot 333n + \log_{10}(aS_1) = 3 \cdot 07$. For $aS_1 = 49 \cdot 5$ the mean intensity is $10^{6 \cdot 019}$. Hence T for a room of volume Wm^3 is given by $\log_{10} W = 8 \cdot 5 + \log_{10} T - (6 \cdot 194/\sqrt{T})$. W. H. Ge.

2418. *New Investigations in Electro-Acoustics.* **H. Riegger** and **F. Trendelenburg.** (Zeits. techn. Physik, 7. 4. pp. 187–191, 1926.)—Using a condenser microphone records are obtained showing the structure of speech sounds, and the structure of the reproductions of these sounds by loud-speakers. Diaphragm and horn loud-speakers are compared as regards their faithfulness of reproduction. Mention is made of acoustic and physiological phenomena that are observed on the introduction of loud-speakers. G. A. S.

2419. *Characteristics of Continuously Tunable Diaphragms.* **L. V. King.** (Journ. Sci. Instruments, 3. pp. 241–245, May, 1926.)—By the use of hydrophones fitted with tunable diaphragms it is now possible to develop submarine signalling along somewhat the same lines as in radio-telegraphy.

It may be expected that considerable advantages will accrue from the use of transmitters giving pure notes over considerable ranges of frequencies, as narrow bands of given frequency may now be picked up to the exclusion of others. Furthermore, by tuning in, the hydrophone is used at its maximum sensitiveness consistent with proper damping, so that it may be possible to receive over considerable distances without the use of valve amplifiers. As submarine signals offer a promising method of assisting navigation and, in combination with radio-telegraphy, of determining distance from lighthouses or light-ships, the possibility of dispensing with such refinements as valve amplifiers may be considered advantageous from the point of view of the navigator of a vessel not equipped with the usual ship's wireless. AUTHOR.

2420. *Loud Speakers as a Source of Sound for Reverberation Work.* **A. H. Davis and N. Fleming.** (Phil. Mag. 2. pp. 51–64, July, 1926.)—It is first shown that the loud-speaker is more adapted to reverberation work than Sabine's organ-pipe method, because it is a source of sound whose activity can be more easily varied over a large known ratio. Instruments are then described by which different loud-speakers can be tested, and results are obtained for an electromagnetic and an electrodynamic loud-speaker in terms of the acoustic amplitude per unit current and loud-speaker current at different frequencies. After establishing the validity of the logarithmic law for the decay in rooms of reverberant sounds of much higher intensities than those used by Sabine, the decay factors (A) for two large rooms are determined in terms of the frequency, in the one case by means of an electromagnetic and in the other by means of an electrodynamic loud-speaker. C. M. R. B.

2421. *Pressure of Elastic Hammer on Pianoforte String.* **P. Das.** (Indian Assoc. for Cultivation of Science, Proc. 9. pp. 297–322, June, 1926.)—Continuing the work of a previous paper, a rigorous treatment of the impact of the yielding elastic hammer upon a point of a stretched string is here given. The method is that of the Kaufmann theory for the unyielding hammer. On account of the very complicated form of the pressure function, the duration of the impact cannot in general be determined algebraically. Six pressure-time graphs are given illustrating the various types of pressure variation produced by varying the elasticity of the hammer. At any instant the pressure is directly proportional to the initial velocity of the hammer. When the hammer is very nearly rigid, a slight diminution in the hardness does not alter very much the duration of the impact, although there is a sensible increase in the duration of the impact on passing from a rigid to a very soft hammer. The paper is purely theoretical. W. H. GE.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

2422. *Some Problems of Electromagnetism.* **C. Rimini.** (Elettrotecnica, 13. pp. 452–454, July 15, 1926.)—To avoid some misunderstandings arising from the general enunciations of the laws of electromagnetism and, in particular, of the relations between work, potential and kinetic energy, the author gives examples illustrating the precautions to be taken to avoid error. E. B.

2423. *Tribo-electricity and Friction.* **P. E. Shaw** and **C. S. Jex.** (Roy. Soc., Proc. 111. pp. 339–355, June 2, 1926.)—Changes in the condition of glass surfaces when rubbed with flexible materials like cotton, linen and silk, are dealt with, measurements being made of (*a*) the electric charges displayed by the glass surfaces; (*b*) the coefficient of friction found between two of them after identical rubbing. The Hankel form of electroscope is used, and a special tilting apparatus for measurement of the coefficient of friction (μ). Amongst the definite effects found are: (1) Owing to adsorption of condensable material the μ of a glass surface slowly descends from 1·2 to about 0·7; (2) ordinary textile materials rubbed on glass quickly reduce μ; (3) very clean textile materials slowly reduce μ; (4) a low value of μ is raised by heating the glass or placing it in a vacuum or in air; (5) the sign of the charge can be made + or − according as the rubbing is along or across the fibre of the yarn used; (6) if one of two identical surfaces of glass be heated and then rubbed on the other, it becomes negative to it. T. B.

2424. *Anomalies in Frictional Electricity.* **G. B. Deodhar.** (Indian Assoc. for Cultivation of Science, Proc. 9. pp. 210–214, June, 1926.)—Anomalous frictional effects have been known since the time of Faraday. Rankine's observation about rough and smooth ebonite rods appears to depart from accuracy when the rubbing is prolonged; the ebonite pieces show reversals of sign. A few more substances are observed; of these india-rubber of red and grey varieties show similar reversals. From the considerable rise in temperature of the rubbing substances and from Jones's observation about definite relationship between the potential and the temperature of the substance, it appears that thermionics play a considerable part in frictional electricity. The reversals in ebonite and rubber may be due to the non-homogeneous nature of these substances. A. D.

2425. *Electrical Double Layer on the Surface of Mercury.* **A. Bühl.** (Ann. d. Physik, 80. 2. pp. 137–180, May 27, 1926.)—Experiments were carried out by vaporising Hg by blowing air over it, by bubbling air through Hg and by letting Hg drops fall on to an obstacle. It was found that, when vaporised, pure gas-free Hg gives only positively charged carriers of a radius $3 - 10 \times 10^{-7}$ cm. while a perceptible electronic layer did not exist. From spectral observations and from its properties at low temperatures it is concluded the carrier must be Hg. When the Hg is in contact with a gas, negative carriers also are produced and a time of 10^{-2} seconds is sufficient. So far as can be traced all gases behave alike for this. Amalgams and even very small amounts of impurities in the Hg cause negative carriers, and this action serves as a test of the purity of the Hg. It is explained that in the outermost molecular layer of the Hg, a narrow region of action exists corresponding to that of the internal pressure of molecular forces, and that free electrons are drawn into the interior by these molecular forces. The thickness of the electronic layer is $1 - 2 \times 10^{-6}$ cm., a distance corresponding to the radius of the sphere of action of Hg. Absorbed gases tend to increase the electronic emission of the Hg molecule, and thus the surface contains some negative charges. Metallic impurities liberate electrons more readily than Hg, and so bring negative charges to the surface layers.

R. S. R.

DISCHARGE AND OSCILLATIONS.

2426. *Experimental Test of the Theory of the Electrodeless Discharge.* **J. K. Robertson.** (Roy. Soc. Canada, Trans. 20. Sect. 3. pp. 143–147, Jan., 1926.)—After a brief discussion of the theoretical side of the question it is shown that while the results give only a fair confirmation of the validity of the relations stated, they are not without value in a consideration of the best use of the electrodeless discharge in spectroscopic research. Attention is directed to the following three points: (1) As far as the magnitude of the electric intensity acting on a gas or vapour is concerned, capacity is of little importance. (2) The electric intensity is increased by decreasing the inductance of the oscillatory circuit. If, therefore, an investigator wishes a high electric intensity to bring out, for example, spark lines, the inductance of the oscillatory circuit should be small. (3) On the other hand, if it is desired to examine successive changes in spectra as the electric intensity acting on a gas or vapour is gradually increased, it is then better to have a high inductance [see also Abstract 1897 (1922)].

A. E. G.

2427. *Experiments on Spark Discharge in Heterogeneous Media—the Mechanism of Lightning Discharge.* **T. Terada, U. Nakaya** and **K. Yumoto.** (Inst. Phys. and Chem. Research, Tôkyô Sci. Papers, No. 52. pp. 129–160, March, 1926. In English.)—The immediate object of these investigations is to study in some detail the mode of excitation as well as the spatial and temporal distribution of the spark discharges which take place on the surface covered with Al dope when different sorts of e.m.f. are applied along the surface. The specimens of materials to be tested are all of cotton fabric treated with caoutchouc to make it gas-tight. One of the surfaces is coated with aluminium dope. The experiments are made along the following lines: Excitation by alternating e.m.f. (*a*) by Tesla apparatus, (*b*) by alternating current of 50 cycle; experiments with statical influence machine; characteristics of different specimens of fabrics; experiments with metallic powder in dielectrics; experiments with the Wommelsdorf machine—(*a*) photograph of thread spark by rotating film, (*b*) photograph of band spark by rotating film, (*c*) microscopic structure of band spark, (*d*) spectrum of the spark; distribution of the tracks of spark on the surface of fabrics; apparent length of spark compared with the ordinary spark length in air; experiments on multiple spark-gap discharge; experiments regarding the coherence and decoherence of metallic powder; experiments with a heterogeneous mixture of grains of conducting and insulating materials; experiments with multiple spark-gaps connected by high resistances; discussion of results. It is suggested that the principle of multiple gaps may be employed to explain the apparent length of spark in the lightning discharge. A. E. G.

2428. *Theory of "Glow" Protective Devices. III.* **F. Kesselring.** (Archiv f. Elektrot. 16. pp. 130–155, May 25, 1926.)—A continuation of previous work [see Abstract 1427 (1926)]. Following a full theoretical discussion of the behaviour of protective devices of the glow, condenser and horned types, a description is given of experimental investigations of all three types. The results obtained show that the glow type is in general superior to the other two. A. W.

2429. *Starting Current and Velocity Distribution with Oxide Kathodes.* **H. Rothe.** (Zeits. f. Physik, 37. 6. pp. 414–418, 1926.)—It is here shown that the velocity distribution of glow electrons which are emitted from the oxide kathodes of technical three-electrode tubes can be measured by observation of the starting currents. It follows the Maxwell distribution law, but the mean velocity of the electrons is 1·5 to 2·2 times as great as the kathode temperature requires according to the kinetic theory of gases [see Abstract 2166 (1926)]. A. E. G.

2430. *Ionisation Potential of Silver.* **G. Piccardi.** (Accad. Lincei, Atti, 3. pp. 489–490, April 18, 1926.)—Foote and Mohler found 7·542 volts; Shenstone found 6 volts; the author finds 7·37 to 7·67 volts, and for reasons given in the paper accepts the figure 7·54. A. D.

2431. *Mobility of Ions in Air. (III) Effect of Organic Vapours.* **A. M. Tyndall** and **L. R. Phillips.** (Roy. Soc., Proc. 111. pp. 577–591, July 2, 1926.)—A continuation of previous work [see Abstract 1435 (1926)] showing a reduction in mobility due to the addition of an organic vapour by an amount depending on the constitution of the vapour and the sign of the ion. The vapours used were the normal aliphatic alcohols, chloroform, carbon tetrachloride, propyl iodide, octane and decane. The effect of a given concentration increases as the alcohol series is ascended, and it is suggested that the effect depends on (1) a "clustering coefficient" determined by the combined effect of any permanent electric moment, and an induced electric moment in the neutral molecule, and (2) the "effective diameter" of the cluster. J. W. T. W.

2432. *Natural Ionisation in Gases.* **J. W. Broxon.** (Phys. Rev. 27. pp. 542–554, May, 1926.)—Frith's experiments on the pressure variation of the natural ionisation in air, nitrogen, oxygen and carbon dioxide inside a 12-in. diameter steel bomb were repeated. Frith's results were confirmed except that it was found that there was no abrupt change in the rate of variation, and no true "saturation" values of the ionisation

were observed at high pressures for small pressure-rate variation. Commercial nitrogen presented no anomalous results. The effects of size of chamber were investigated, and although no unidirectional effect was found it was seen that of three spheres of 7-in., 9-in. and 12-in. diameters respectively, the rate of production of ions per c.c. was least for the 9-in. sphere at high pressures. The effects of lining with aluminium and copper are recorded, and it was found that the former increased the ionisation at low pressures and decreased it at high pressures. Copper acted similarly at high pressures. The effect of water-vapour was negligible, and the effects of slow chemical reactions were found impossible to determine by this method, as experiments yielded negative results.
S. G. B.

2433. *Independence of Sparking Potential on Temperature.* **B. Frey.** (Ann. d. Physik, 80. 4. pp. 408–414, June 22, 1926.)—Burton's results apparently showed that the sparking potential was a function of the temperature [Abstract 1424 (1926)]. Discussion of Meyer's work [Abstract 1812 (1921)] and experiments now described show that the minimum potential in very dry gas is independent of the temperature, and that Burton's results can only be attributed to variations of humidity in the gas employed.
A. W.

2434. *Compensation of the Anode Reaction Effect.* **L. Müller.** (Archiv f. Elektrot. 16. pp. 251–260, June 14, 1926.)—This is a mathematical and experimental investigation on the elimination of the back coupling effect of the anode circuit on the grid circuit of an amplifier, arising from the grid-anode capacity of the valve. The fundamental principle of the method is to compensate the grid current by a current of equal magnitude and frequency, but opposite in phase, and this is achieved in a four-electrode valve by the insertion of a resistance R_r in the space-charge grid circuit. The analysis shows that if C_{ga} is the grid-anode capacity, C_{gr} the capacity between grid and space-charge grid, and R_a the anode circuit resistance, then the condition for phase compensation is $C_{ga}R_a = C_{gr}R_r$. In multi-stage amplifiers the simplest manner of effecting compensation at all frequencies is to divide the primary of the intervalve transformer, part being in the anode circuit, and part in the space-charge grid circuit, the division being at the mid-point if the two capacities are equal; the coupling between the two parts is shown to have a negligible effect. Experimental measurements verify the mathematical theory.
E. T. A. R.

2435. *Stability Conditions and their Dependence on Regulating Arrangements and Energy Storage.* **E. Friedländer.** (Phys. Zeits. 27. pp. 361–366, June 1, 1926.)—It is found that the stability conditions for a single-storage system is generally fulfilled when the closing resistance of the storage is positive. If the equilibrium position with a single-storage system is stable, the stability can be easily disturbed by introducing a suitable small storage, but the lability of the equilibrium position cannot be so disturbed. With a given oscillating system the characteristic of the regulating arrangements decides the kind and stability of the originating oscillations. [See also Abstract 1422 (1926).]
A. E. G.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2436. *Hall's Phenomenon in Antimony with Weak Fields.* **Maria Campa.** (N. Cimento, 3. pp. 177–183, April, 1926.)—Investigation of the changes undergone by Hall's coefficient in antimony through temperature, annealing and through the action of mesothorium radiations in a weak magnetic field. The following conclusions were reached: (1) Within the limits of the field employed, *i.e.* between zero and about 780 gauss, the Hall-effect is proportional to the field. (2) The law of variation of R with the temperature is linear and in the direction of diminution with a rise in temperature. The annealed discs of metal are more sensitive to variation than the unannealed, having a thermal coefficient almost double that of the latter. (3) At the surrounding temperature the discs examined had a Hall's coefficient of 0·242 for the unannealed and 0·262 for the annealed. The annealed and the chill-cast discs were obtained by slow or rapid solidification. (4) Mesothorium radiations, acting during solidification, produce a diminution of the coefficient of from 17 % to 13 %. Several tables of numerical results are given. E. F.

2437. *Changes in Electrical Conductivity with Cold Working.* **W. Geiss** and **J. A. M. v. Liempt.** (Zeits. f. Metallkunde, 18. pp. 216–218, July, 1926.)—The changes in electrical conductivity of tungsten wire during cold working was investigated, with a view to elucidating the influence of the space-lattice parameter changes on the conductivity. The conductivity of wire drawn from one crystal was compared with that of the many crystal wire, and considerable difference was found between them. The phenomenon was explained as a consequence of deformation of the orbits of the valency electrons, and the results are in harmony with the changes in other physical properties. An explanation of the α and β allotropy of iron is given. F. J. B.

2438. *Conductivity of Dilute Amalgams.* **T. I. Edwards.** (Phil. Mag. 2. pp. 1–21, July, 1926.)—The specific resistance (ρ_t) of mercury in a quartz tube over a temperature range of 0 – 300° C. is given by $\rho_t = \rho_0(1 + 0{\cdot}0_3 8877t + 0{\cdot}0_6 977t^2 + 0{\cdot}0_9 19t^3)$, where t is the temperature. Measurements were made of the conductivity at various temperatures of dilute amalgams of thallium, germanium, antimony, yttrium, cerium and aluminium. The relative change of conductivity with respect to mercury at the same temperature is proportional to the concentration. For thallium amalgams the temperature coefficient of increase of resistance decreases with increase of concentration. Examination of the results in relation to the Skaupy theory showed that the value of $(1/c)(\Delta L/L)$ at infinite dilution was of the *same order of magnitude* for the amalgams examined, from which it would follow that atom for atom the effect of the different metals on the conductivity of mercury is about the same.

W. H. Ge.

2439. *Determination of Dielectric Constants of Good Conducting Substances.* **H. Zahn.** (Ann. d. Physik, 80. 2. pp. 182–190, May 27, 1926.)—Dielectric constants of good conducting substances are measured by a resonance method, and a comparison is made with the results given by a measurement of the decrement. The material is placed in a condenser which forms part of an oscillating circuit of high frequency and is loosely coupled to a second circuit of a standard frequency. The substance is then replaced by an adjustable condenser in parallel with a variable resistor W, and these are adjusted until the original periodicity and amplitude are restored. The periodicity n is determined by the expression: $n = 1/2\pi\sqrt{1/LC' - R'^2/4L^2}$ where $R' = R + L/WC$ and $C' = CW/(W + R)$. C is the capacity and L the inductance of the condenser, and R is the ohmic resistance of the resistor. With substances of high conductivity R can be neglected compared with W, and $n = 1/2\pi C\sqrt{C/L - 1/4W^2}$. The decrement $\delta = R'/2Ln = 18\pi\sigma 10^{11}/\epsilon n$, where ϵ is the dielectric constant and σ the conductivity. For electrolytes of low conductivity, *e.g.* below 5×10^{-4}, it is found more accurate to derive the dielectric constant from the displacement of the resonance position, and for those of high conductivity from the decrement values. [See Abstracts 1479 and 2359 (1925).] J. N. P.

2440. *Dielectric Constants of Good Conducting Electrolytes.* **H. Hellmann** and **H. Zahn.** (Ann. d. Physik, 80. 2. pp. 191–214, May 27, 1926.) —By the application of the relation derived in an earlier publication [see preceding Abstract], estimations of dielectric constant are made from the amplitude of the oscillations of the circuit when in resonance with a standard circuit. The damping or dielectric absorption which is brought about in solutions by the bipoles of the solute gives a component of current which is in phase with the e.m.f. in place of 90° as with a perfect condenser. A phase displacement is thus produced which appears as a power loss. The effect is reproduced by the use in the oscillating circuit of a parallel wire condenser in series with a non-inductive resistance. The following expressions are derived and employed to evaluate the dielectric constant:—

$$\eta^2 = \frac{(1 - \alpha\gamma)^2 + (\alpha\beta)^2}{(1 + \alpha\gamma)^2 + (\alpha\beta)^2}, \qquad \eta'^2 = \frac{(R' - 1/cK)^2 + \omega^2 L'^2}{(R' + 1/cK)^2 + \omega^2 L'^2},$$

$$\epsilon = \lambda\sqrt{\frac{2\gamma}{\alpha}\frac{1 + \eta'^2}{1 - \eta^2} - \left(\gamma^2 + \frac{1}{\alpha^2}\right)},$$

where ϵ is the dielectric constant, η' the absorption or decrement with the parallel wire system in series with an adjustable non-inductive resistance, and η the absorption when the liquid-filled condenser forms part of the circuit, λ is the wave-length, $\gamma = 60\sigma$, where σ is the specific conductivity in mhos, $\alpha = 2\pi C/K$, where C is the capacity in cm. of the unfilled condenser and K is the capacity of unit length of the parallel wire system, $\beta = \frac{\epsilon}{\lambda}$. R′ is the direct-current resistance of the circuit and L′ the inductance. The method can be applied for solutions which have a resistance as low as 0·1 ohm/cm. A further expression which is employed for the determination of dielectric constants of a series of liquids in which the conductivity varies but the dielectric constant is the same is of the form $\epsilon = 60\lambda\sigma_{(\text{min.})}$, where $\sigma_{(\text{min.})}$ is the conductivity of that solution which has a minimum decrement of amplitude. [See Abstract 373 (1926).] J. N. P.

2441. *Photoelectric Experiments at Fluid Surfaces.* **W. Zimmermann.** (Ann. d. Physik, 80. 4. pp. 329–348, June 22, 1926.)—The present experiments are undertaken to extend the knowledge of the exact formation of surface layers of fluids, especially of watery solutions; for this purpose the photoelectric sensitivity of free fluid surfaces in ultra-violet light is investigated. Only solutions of ferrocyanide are operative without solid surface. The dependence of the photoelectric action of the ferrocyanides of Li, Na, K, on the concentration is measured. There is found to be a quantitative connection between the undissociated molecules contained in the ferrocyanide solutions and photoelectric action and for the influence of the ions of Li, K and Na. It is shown that in the outermost molecular layers of the surface of ferrocyanide solutions there are undissociated molecules. The photoelectric action of solid salts is also measured, and among these ferrocyanide is found to be especially active. Many salts are active which show no activity when in solution. A. E. G.

2442. *Photo Effect in Crystals.* **P. Lukirsky, N. Gudris and L. Kulikowa.** (Zeits. f. Physik, 37. 4–5. pp. 308–318, 1926.)—By Millikan's method the photoelectric effect was observed in the following crystals: NaCl, KCl, RbCl, CsCl, CuCl, NaBr, KBr, NaI, KI, RbI, CsI, NaF, KF, LiF, $CdBr_2$. By means of spark illumination it was possible to determine the limit of the photo-effect ($h\nu_0$). An attempt is made to establish a relation between the results obtained and the structure and other phenomena observed during the illumination of the crystals. Numerical results are given in four tables. E. F.

2443. *Properties of Mutual Inductance Standards at Telephonic Frequencies.* **L. Hartshorn.** (Phys. Soc., Proc. 38. pp. 302–319; Disc., 319–320, June, 1926.)—It is well known that when a mutual inductance carries alternating current the value of the effective mutual inductance varies with the frequency, and further that the secondary p.d. is not exactly in quadrature with the primary current. Thus certain frequency corrections are introduced into all alternating-current bridges in which a mutual inductance standard is used. An experimental investigation has been made of the actual magnitude of such corrections for mutual inductance standards of three types: (1) A stranded wire fixed standard, with spaced winding to minimise capacity effects; (2) the Campbell variable mutual inductance standard; (3) the Tinsley variable mutual inductance standard made in accordance with Butterworth's recommendations. Values of the corrections are given for all these instruments under various conditions. It is shown that whereas the variation of mutual inductance with frequency is mainly due to capacity effects, dielectric losses in the insulation, or alternating-current conductance, play an important part in the determination of the phase defect, the impurity being found to be proportional to a power of the frequency higher than the second, over the telephonic range of frequency. [See also Abstract 1737 (1925).] AUTHOR.

2444. *Demonstration of Some Simple Experiments with Thermionic Valves.* **E. H. Rayner.** (Phys. Soc., Proc. 38. pp. 335–336, June, 1926.)

2445. *Calculation and Application of High Resistances of Small Self-Inductance for all Frequencies.* **R. M. Wilmotte.** (Phil. Mag. 2. pp. 65–86, July, 1926.)—With high resistances of the order of several thousand ohms, used in alternating-current measurements, difficulties arise owing to the residual self-inductance and the effect of capacity; the effects become more pronounced as the frequency increases, and the effect of capacity, which is negligible for low resistances, becomes very great. Formulæ are given for high resistances formed of long parallel wires of circular cross-section, screened from earth by a cylindrical metal shield, the wires being parallel to the axis of the cylinder. Formulæ are also given for the use of such a resistance as a ratio arm and potential divider together with its use in bridges. A 10,000-ohm standard is described of No. 47 manganin wires, forty of which, about 106 cm. long, are stretched parallel to one another on the surface of an imaginary cylinder 1·8 in. in radius; the internal radius of the screening cylinder is 2 in. The wires are connected to terminals at one end, and are held taut by springs, from which they are insulated, at the other; alternate pairs are connected together at the latter end. Any even number of wires may be used in series, and they may be arranged as bridge arms with varying ratio. H. N. A.

2446. *Discharge Oscillograph.* **V. Engelhardt.** (Zeits. Instrumentenk. 46. pp. 240–246, May, 1926.)—Deals with the application to oscillograph work of the relation between current strength and discharge in a gas discharge-tube. W. H. Ge.

2447. *Amplifier Transformers.* **L. Müller.** (Archiv f. Elektrot. 16. pp. 219–250, June 14, 1926.)—A comprehensive theoretical discussion is first given. This is divided into five sections dealing with (1) coil capacities, iron and copper losses, leakage, etc.; (2) resonance frequencies, fundamental equations; (3) short-circuit conditions; (4) transformation ratio; (5) amplifier transformers with short-circuited windings. A description is then given of experimental work on twenty-two transformers of three types, one type having a closed iron circuit, a second having a straight core of iron wires and enclosed in a screen consisting of soft iron with copper outside, the iron circuit being nearly closed, and the third having an open iron circuit. Experimental methods are fully described and many interesting results are illustrated graphically. Among these are diagrams showing the effects of internal short-circuits and of breaks in a transformer secondary winding. A. W.

2448. *The Measurement of Very Small Currents.* **L. Hartshorn.** (Journ. Sci. Instruments, 3. pp. 297–301, June, 1926.)—In order to avoid the necessity for calibrating an electrometer for measuring very small currents, such as those due to leakage, a null method is employed in which an equivalent current is produced by varying the capacity of a charged condenser so that the electrometer is kept at zero. The application of the method and its sensitivity are discussed. Author.

2449. *An Accurate Adjustable Contact Breaker.* **J. L. Parkinson.** (Journ. Sci. Instruments, 3. pp. 303–305, June, 1926.)—A revolving contact-breaker is described which is capable of providing intervals (*e.g.* that of the passage of a constant current or that between two induction shocks) from 0·001 to 9 seconds. The driving power is derived from a gramophone motor, the speed of which from one winding is constant over about 100 revolutions, and is attained within one-eighth of a revolution starting from rest. Such an instrument was originally designed by the late K. Lucas, but has never been described. In a slightly modified form it has been found to be of the greatest use in physiological and other experiments. AUTHOR.

2450. *Supplementary Note on the Paschen Galvanometer.* **H. A. Daynes.** (Journ. Sci. Instruments, 3. pp. 329–331, July, 1926.)—The effect of varying the number, length and thickness of the magnets on the sensitiveness of the galvanometer is considered, and its influence on the design. [See also Abstract 607 (1926).] AUTHOR.

2451. *A Simplified Moving Magnet Galvanometer with a High Figure of Merit.* **A. C. Downing.** (Journ. Sci. Instruments, 3. pp. 331–335, July, 1926.)—A new moving magnet galvanometer of the Thomson type, having a "figure of merit" up to 35,000 and considerable stability of zero, is described. Its simple design and its small size have not only greatly increased the utility of the instrument, but considerably lowered the cost of its manufacture. AUTHOR.

2452. *A "Mumetal" Magnetic Shield for a Sensitive Galvanometer.* **A. V. Hill.** (Journ. Sci. Instruments, 3. pp. 335–336, July, 1926.)—A magnetic shield for a sensitive galvanometer has been constructed of "mumetal" strip, wound alternately with copper strip on a copper cylinder, and closed at each end by two mumetal plates separated by a copper plate. In spite of its small size and weight, this shield is extremely effective, showing a screening ratio of about 1000 against small external magnetic fields. AUTHOR.

2453. *A Vacuum-tube Multimeter for Radio-frequency Measurements.* **M. Y. Colby.** (Journ. Sci. Instruments, 3. pp. 342–347, July, 1926.)—A method is given of constructing and calibrating a multirange portable instrument for measuring small values of alternating current and electromotive force. Two triodes are used, one functioning as a cumulative grid rectifier, the other as an amplifier. The readings of the instrument are shown to be independent of frequency, and likewise independent of the nature of the circuit to which the instrument is connected. AUTHOR.

ALTERNATING CURRENTS AND MAGNETISM.

2454. *A Demultiplier of Static Frequency.* **J. Fallou.** (Rev. Gén. d'Él. 19. pp. 987–991, June 19, 1926.)—The author here shows how it is possible to maintain a periodic oscillation by resonance of one of the superior harmonics of that oscillation. It is evidently necessary that the oscillation maintained must not be purely sinusoidal; in the case of an electric oscillation it is sufficient that Ohm's law is not applicable to the circuit. This principle ought to be able to explain certain phenomena still obscure in the functioning of multipliers of frequency with triode lamps or with ferro-resonance, and to find applications in other branches of physics. It also leads to a practical means of demultiplying the frequency of a source without the aid of rotating machines. The paper is illustrated with oscillograms and schemes of various circuits. [See also Abstract 1461 (1926).] A. E. G.

2455. *Loss of Energy in Metal Plates of Finite Thickness due to Eddy Currents produced Magnetically.* **E. W. Marchant** and **J. L. Miller.** (Roy. Soc., Proc. 111. pp. 604–614, July 2, 1926.)—When eddy currents are produced in a metal plate by an alternating magnetic field normal to the plate, the total loss of energy is sometimes greater in thin plates than in thicker ones. The authors have measured the energy loss by finding the increase in effective resistance of an inductive coil brought near the plate. For copper plates the loss curve shows a maximum at about 0·5 cm. thickness, while for zinc the maximum is less marked and is at about 1 cm. These results are shown to agree with the mathematical theory developed in a second part of the paper. J. W. T. W.

2456. *Tracing of Magnetisation Curves with the Braun Tube.* **K. Krüger** and **H. Plendl.** (Zeits. f. Hochfrequenztechn. 27. 5. pp. 155–161, 1926.)—A method is described for the direct tracing of alternating-current magnetisation curves of closed and open-cored specimens by means of the Braun tube. The kathode-ray is deflected in one direction by the magnetic field of a pair of coils carrying the alternating current, which also flows through a primary coil wound on the specimen; in the secondary circuit is a high ohmic resistance in series with a condenser, the instantaneous voltage across which is proportional to the magnetic flux; this voltage is amplified by thermionic valves and applied to a pair of plates in the tube to give a second deflection at right angles to the first. The curve traced is thus the ϕ-i curve. A complete discussion is given of the accuracy of the method and the precautions to be observed. A number of tracings are given showing the effects of saturation, thickness of laminations, size of air-spaces and superimposed direct-current magnetisation on the shape of the magnetisation curves. [See also Abstract 378 (1926).] E. T. A. R.

2457. *Large Discontinuity Phenomena in the Magnetisation of Nickel and the Acquisition of a Particularly Simple Cycle.* **R. Forrer.** (J. de Physique et le Radium, 7. pp. 109–124, April, 1926.)—On repeating the experiments of Barkhausen [see Abstract 443 (1920)] on the discontinuities of magnetisation, the author shows that for an ordinary nickel wire these discontinuities may be heard in a telephone without amplification and become stronger when the wire has been drawn out till breaking, curved and straightened. The hysteresis loops taken with a magnetometer show sudden changes in magnetisation which attain to a tenth of the height of the cycle. These discontinuities have been studied with a magnetometer giving rapid indications, the cycles being thus obtained on photographic paper. The cycles have the following properties: For fields below the coercive force the magnetisation is almost reversible. On the irreversible portion the magnetisation varies by very irregular steps, of which two jumps, situated at the beginning and centre of the ascending branch, reach an important fraction of the entire magnetisation. These properties persist, annealing at 400° C. having no effect, it being necessary to reach 720° C. to return to the usual nickel cycles. The author shows that a treatment involving drawing, rolling round a cylinder, and then holding against its elasticity in a straight capillary tube produces remarkable results. The cycle is now a parallelogram, the two characteristic properties of reversible and irreversible magnetisation being completely separated. The reversible portions are rigorously straight and their small slope the same for different cycles. The irreversible magnetisation is attained suddenly (and corresponds to some 97 % of the height of the cycle) for a value of the field which is the same for all cycles. W. V. M.

RADIOGRAPHY AND ELECTRO-PHYSIOLOGY.

2458. *Radiology in Urinary Surgery.* **J. Thomson-Walker.** (Brit. J. of Radiology, 22. pp. 91–114, July, 1926. The Ninth Silvanus Thompson Lecture.)—This paper is purely medical in its nature, and deals with radiological procedure for diagnosis and treatment. Whilst an important paper from this aspect, the purely physical aspects are not considered. B. J. L.

2459. *X-Ray Dosage.* **A. Dauvillier.** (Brit. J. of Radiology, 22. pp. 115–127, July, 1926.)—The mechanism of the action of X-rays on matter is discussed with particular reference to the relative values of scattered radiation and selectively absorbed radiation with variation of wave-length. The problem of dosage measurement is then considered and an ionisation instrument described, which permits X-ray intensity to be measured in ergs. [See Abstract 862 (1924).] B. J. L.

2460. *Coloured X-Ray Shadows upon Fluorescent Screens.* **C. E. S. Phillips.** (Brit. J. of Radiology, 22. pp. 130–131; Disc., 131, July, 1926.)—The author applies the phenomenon of complementary colours to illuminate an X-ray fluorescent screen and so to produce red or green coloured images. Without suggesting any practical use of the experiments, the possible effect of better contrast by such methods is pointed out. B. J. L.

2461. *Experiments with Uranium X.* **C. E. S. Phillips.** (Brit. J. of Radiology, 22. pp. 132–133; Disc., 133, July, 1926.)—A demonstration was given of methods of concentrating uranium X from uranium nitrate for the purposes of therapeutical application as plasters and injections. The methods used are not specified, but details are promised in a later paper. B. J. L.

2462. *X-Rays and Living Matter.* **J. A. Crowther.** (Nature, 118. pp. 81–88, July 17, 1926. Substance of two lectures delivered before the Roy. Inst., Jan., 1926.)—A general account is given of radiology and the difficulties which arise due to difference of exciting voltage waveform and difficulties of intensity measurement. Reference is made to experiments by Moffett indicating considerable selective effects in the action of X-radiation. The paper concludes with speculations as to the biological action of X-radiation. B. J. L.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

2463. *Chemistry as a Branch of Mathematics.* **L. H. Adams.** (Washington Acad. Sci., J. 16. pp. 266–276, May, 1926. Paper read before the Chem. Soc. Washington, Jan., 1926.)—Various points of contact between chemistry and mathematics are discussed and the necessity of making increased use of mathematical methods in chemical investigation is emphasised. Reference is made to, *inter alia,* (1) the graphic representation of data, the uses of coordinate paper with either a logarithmic or a double logarithmic scale, the plotting of the logarithm of one quantity against the reciprocal of another, the deviation curve; (2) the selection of an equation; (3) the phase rule and chemical thermodynamics; (4) chemical affinity; and (5) the mechanics of the atom. T. H. P.

2464. *Studies in Adsorption. XIII. Schulze-Hardy Law and Adsorption.* **N. R. Dhar and S. Ghosh.** (J. Phys. Chem. 30. pp. 628–642, May, 1926.)—The results of adsorption experiments with a number of different sols fail to support the common view [Abstract 1754 (1925)] that an ion which is highly adsorbed also possesses a high coagulating power. Moreover, no justification is apparent for the assumption that the adsorption of an ion increases with its valency and hence with its coagulating power. On the other hand, experiments on the coagulation and adsorption of different ions by sols of mercuric sulphide, antimony trisulphide, aluminium and ferric hydroxides, manganese dioxide, etc., strongly support the authors' view that the greater the valency of an ion the less is its amount of adsorption, and the smaller the coagulating power of an ion the greater is its power of adsorption. The large amount of adsorption of ions associated with the coagulation of sols such as manganese dioxide, ferric, aluminium and chromium hydroxides, etc., is due mainly to marked chemical affinity of these substances for various ions. The general conclusion indicated is that the valency of an ion is probably a more important factor in coagulation than its adsorbability.

T. H. P.

2465. *Capillary Condensation and Adsorption.* **W. C. Bray** and **H. D. Draper.** (Nat. Acad. Sci., Proc. 12. pp. 295–299, May, 1926.)—Sorption isotherms for water-vapour on partially hydrated CuO, MnO_2 and mixtures of the two oxides are determined, the curves showing a rapid increase in sorption at higher pressures. A similar result is obtained in one experiment with MnO_2 and ether. In every case 85–90 % of the sorption takes place at pressures greater than one-half the vapour-pressure of the pure liquid. It is also indicated that the sorption of water by CuO involves true adsorption at low pressures and capillary condensation at the higher pressures. The relation of the results obtained to the theories advanced by McBain and others is discussed. A. B. C. L.

2466. *Adsorption. Parts II and III.* **F. G. Tryhorn** and **W. F. Wyatt.** (Faraday Soc., Trans. 22. pp. 134–145; Disc., 145–146, May, 1926.)—In Part I of the investigation [see Abstract 1136 (1926)] the authors described experiments on the adsorption of vapours of binary liquid mixtures by coconut charcoal. The method of determination was to weigh the amount adsorbed by a gramme of charcoal while suspended above the surface of the given liquid in an almost enclosed space. The adsorptive power of purified coconut charcoal was determined at 20° C. for fourteen liquids. The initial rate of adsorption was found to be in accordance with the laws of diffusion—that is, inversely proportional to the square root of the molecular weight of the liquid and proportional to its vapour-pressure. Eleven of the liquids showed that the velocity of adsorption was a discontinuous function of time, and the suggestion was put forward that a sudden formation of a liquid surface in the charcoal accounted for the discontinuity. The experimental methods in determining the stages in the adsorption by coconut charcoal from the vapour mixtures of benzene and alcohol and benzene and acetone were similar to those used in the previous work, but the tubes were sealed instead of corked. It was found that the adsorption curves consisted of three parts. The first stage is the adsorption of the two components in a constant ratio which is the same as that existing in the vapour phase. Condensation to a liquid occurs in the charcoal when the density of the adsorbed vapour exceeds a certain value. This is the second stage. The third stage is the isothermal distillation of the bulk liquid into the intergranular spaces of the charcoal. F. J. B.

2467. *Adsorption of Gases by Glass and Silver Powders.* **F. Durau.** (Zeits. f. Physik, 37. 6. pp. 419–457, 1926.)—Measurements of the number of gas-layers deposited. Results not in agreement with Regener's hypothesis [see Abstract 907 (1921)]. Carbon dioxide on glass and hydrogen and nitrogen on silver present pure adsorptions, while with air on silver there is also a chemosorption. A. D.

2468. *Binary Mixtures.* **G. C. Schmidt.** (Zeits. phys. Chem. 121. pp. 221–253, June 10, 1926.)—The theory of Dolezalek [Abstract 1328 (1909)] is tested, according to which liquid mixtures may be divided into three classes. In the first the liquids contain only single molecules and undergo no combination, and the change of vapour-pressure with composition is linear. In the second the liquids consist of single molecules which enter into chemical combination and give a vapour-pressure curve which is convex downwards. In the third category one liquid consists of single molecules, while the second is more or less polymerised and decomposes on mixing. The resulting vapour-pressure curve is concave downwards through the increased vapour-pressure of the single molecules. Similar relations are found to apply to other properties, such as volume and dielectric constant. The theory requires that the molecular proportion of a non-electrolyte in a solution is proportional to the partial pressure of its vapour above the solution. The applicability is discussed of formulæ derived by Dolezalek in which the partial pressure of a component of a mixture is expressed in terms of concentration. Data are given for a large number of compounds of the heat evolution and volume change on mixing two liquids in varying proportions, and the relation of these values to the state of aggregation of the molecules is discussed. No correlation can be obtained between volume change and the course of the vapour-pressure curves or between heat and volume change on mixing. It may be generalised that when the vapour-pressure curve is concave dissociation of associated liquids occurs and heat is absorbed on mixing, while a convex vapour-pressure curve denotes combination with liberation of heat. It is considered that the Dolezalek theory is only approximately valid, and that from it nothing definite can be inferred on the structure of pure liquid molecules. J. N. P.

2469. *Periodicity of Colloidal Reactions.* **W. Kopaczewski** and **W. Szukiewicz.** (Comptes Rendus, 182. pp. 1276–1278, May 25, 1926.)—On adding sodium oleate solution of 1 % concentration to some typical colloidal suspensions such as congo-red, the freshly-prepared solution at first increases the surface-tension and then causes flocculation of the colloid and lowering of the surface-tension, which is again followed after an interval of about three days by increase of surface-tension, and the changes follow periodically at gradually increasing intervals until flocculation has occurred. This effect is related to the degree of hydration of the colloid which fluctuates periodically. Other physical properties of the colloids which are measured, such as viscosity, electrical conductivity, and H-ion concentration, are found to fluctuate with time in a manner parallel to that of the surface-tension. In investigating colloidal reactions, the necessity is shown of taking into account the age of the sol. The observed periodicity of the colloidal reactions may account for the periodical variations which have been found in the permeability of living membranes. J. N. P.

2470. *The Movement of Colloidal Particles in an Alternating Electric Field of Varying Frequency. Correction to Former Publication.* **O. Blüh.** (Ann. d. Physik, 80. 2. p. 181, May 27, 1926.)—In the expression derived to relate the amplitude of the movement of colloidal particles to the frequency of the alternating field [see Abstract 1678 (1926)] the formula is further amended to $H\nu = C/(1 + a\sqrt{\nu})$ in place of $C(1 + a\sqrt{\nu})$. The conclusion of the slip of the particles from their surrounding medium at high frequencies is maintained. J. N. P.

2471. *The Colloidal Properties of Nitrocellulose Sols in Mixed Solvents.* **A. Highfield.** (Faraday Soc., Trans. 22. pp. 57–75; Disc., 76–81, March, 1926.)—The colloid properties of nitrocellulose sols are investigated by means of the determination of viscosity which, with certain limitations, is taken as a criterion of solvent power. The method of determining solubility by precipitation through the addition of a presumed inert liquid is found to be invalid. Measurements are made by the falling sphere method of the viscosities of a large number of 4 % sols of nitrocellulose of varying nitrogen content in different mixtures of ether, alcohol, water and acetone, alcohol, water. Ternary diagrams are constructed and illustrate the manner in which the water content of the solvent of minimum sol viscosity changes with the ether-alcohol or acetone-alcohol ratio. By varying the nitrogen content of the nitrocellulose, it is seen that modifications in the viscosity relationships are produced, and these are related to an alteration in the hydroxyl content of the nitrocellulose. The lower the nitrogen content of the nitrocellulose the higher its hydroxyl content, and this is accompanied by a corresponding increase in the hydroxyl (water or alcohol) content of both the solvent of minimum sol viscosity and of the range of solvents which effect solution. The results are explained by an extension of the Langmuir-Hildebrand theory in which a specific attraction is assumed between similar groups in solute and solvent. It is shown that nitrocellulose and its solvents contain both strongly and weakly polar groups. Mixed liquids are solvents if they contain these two classes of groups balanced in suitable proportions, and this conclusion holds whether the ingredients of the mixture are solvents or not. The conclusions are further supported by measurements made with other solvent systems such as aniline-alcohol-nitrobenzene. J. N. P.

2472. *Energy of Solution of Gaseous Ions in Relation to the Effect of a Charge upon the Dielectric.* **W. M. Latimer.** (Am. Chem. Soc., J. 48. pp. 1234–1239, May, 1926.)—Born [Abstract 171 (1921)] pointed out that if the ions be considered as spheres of radius r and charge e, the energy of solution should be given by the expression $\Delta E = (e^2/2r)(1 - 1/D)$, where D is the dielectric constant of the solvent. From the data then available Born concluded that the values of the radii of the positive ions computed from the energies of solution were mostly smaller than those calculated by Bragg and Bragg from crystal structures for the effective atomic radii. For fourteen ions, however, the author finds that very close agreement exists between the two series of values for the radii. Furthermore, the energy of solution of the positive ions is almost wholly due to the effect of the charge upon the dielectric. The results appear to lead definitely to the conclusions (1) that specific energy of combination of the various ions with water is small in comparison with the effect of the ion as a charged particle upon the water as a dielectric, and (2) that the effective size of the ions in terms of the distance of approach of a water molecule corresponds very closely with the effective sizes calculated from crystal data. Approximate values for the entropies of ions in aqueous solution are given, and values for the electron affinities of chlorine, bromine and iodine are calculated. T. H. P.

2473. *Determination of the Concentration of Liquid Soaps by the Immersion Refractometer.* **L. F. Hoyt** and **Alma Verwiebe.** (Indust. and Engin. Chem. 18. pp. 581–582, June, 1926.)—The Zeiss immersion refractometer is employed for measuring the refractive index of aqueous potash soap solutions made from a variety of saponified vegetable oils or their fatty acids. The slope of the curves obtained by plotting refractive indices against total solids of the different aqueous potash soaps is directly proportional to the refractive index of the oils. The method is particularly adapted to the analysis, during manufacture, of liquid soaps whose fat base is known and available. The total solids content can be rapidly determined with an accuracy of 0·05 %. Use is made of the formula $y = ax + k$, where y is the observed refractive index, x is the concentration of soap, a is the slope calculated from the equation of the curve, and k is the refractive index of water. J. N. P.

2474. *Velocity of Diffusion and Solvent.* **G. E. Muchin** and **G. P. Faermann.** (Zeits. phys. Chem. 121. pp. 180–188, June 10, 1926.)—Results are given of measurements of the velocity of diffusion of acetic acid and aniline in alcohol, benzene, acetonitrile and mixtures of these solvents. Neither with the pure solvents nor with the mixtures is the proportionality between viscosity and constant of diffusion required by Einstein's formula [see Abstract 1122 (1908)] observed. In order to explain the rôle of the solvent, account must be taken not only of the viscosity but also of the influence exerted by the chemical character of the solvent and by its specific action with the solute, as regards both the alteration of its molecular condition and the formation of solvate.

T. H. P.

2475. *Properties of Ammonium Nitrate. I, II and III.* **N. L. Bowen.** (J. Phys. Chem. 30. pp. 721–737, June, 1926.)—I. By direct observation of the optical properties under the petrographic microscope it is found that ammonium nitrate exhibits, in addition to the various well-known crystalline changes, also a reversible transformation at approximately 50°, corresponding with the change, orthorhombic (IV) $\rightleftarrows$ tetragonal (II). At this temperature both forms are metastable, yet the transformation is in many respects more prompt and dependable than most of the stable inversions. Extrapolation of Bridgman's values for the II $\rightleftarrows$ IV inversion at high pressures [Abstract 343 (1917)], for which it is a stable transformation, indicates the temperature 50·5° for this change at atmospheric pressure.

II. Re-examination by the same method of the system ammonium nitrate-ammonium chloride gives results agreeing with those of Perman (Chem. Soc., J. 121. p. 2473, 1922) as to the position of the liquidus curves and the eutectic, but revealing also a series of solid solutions. All mixtures containing from 0 to 8 % of the chloride crystallise to a homogeneous mixed-crystal phase of isometric symmetry. Owing to the existence of this series, the phenomenon of the eutectic does not occur until the limits of solid solution are passed, each member of the series beginning to melt at a successively higher temperature as pure ammonium nitrate is approached.

The isometric (I) $\longrightarrow$ tetragonal (II) inversion changes from 125·5° for the pure nitrate to 109° for the solid solution containing 3·5 % of the chloride. At 109° the curve of unmixing of solid solutions is encountered, and along this curve the phenomena of mixing and unmixing of solid solutions take place and can be directly observed.

III. The rising liquidus in the system ammonium nitrate-ammonium sulphate is due, as Perman and Howells conclude (Chem. Soc., J. 123, p. 2130, 1923), to solid solution and not to the limiting position of the eutectic, as suggested by Freeth (J. Phys. Chem. 29. p. 506, 1925). T. H. P.

2476. *Studies with the Microbalance. Part IV.* **E. J. Hartung.** (Chem. Soc., J. pp. 1349–1354, June, 1926.)—The photochemical decomposition of silver iodide was studied by means of the microbalance. The maximum percentage loss of total iodine in thin films of silver iodide when suitably isolated was: 91·6 % in hydrogen, 88·5 % in nitrogen, and 94·0 % in oxygen. The products of the photochemical decomposition are silver and iodine, and oxygen is not necessary for the change. Extensive action was only found at low gas-pressures in the presence of silver as an iodine absorbent. The rate of iodination of silver and of previously isolated silver iodide was studied, and close agreement was shown to exist between them for similar concentrations of iodine vapour. No evidence was forthcoming in support of the formation of silver sub- or poly-iodides as a result of the decomposition. F. J. B.

2477. *Determination of the Current-Voltage Characteristic of a Siemen's Ozoniser.* **R. W. Lunt.** (Phil. Mag. 2. pp. 314–316, July, 1926.)—When using an ozoniser consisting of concentric cylinders of glass or other insulator, it is often desirable to cool one or both elcetrodes in order to reduce thermal effects to a minimum. Appropriate electrical connections are then very necessary to the determination of the true current flowing through the ozoniser and the voltage associated with it. A typical circuit in which an ozoniser is connected to a source of high-tension alternating current is represented diagrammatically. Two methods that have been found to obviate a difficulty that arises in the cooling of the high-tension electrode are explained, in one of which a silica vessel is employed to withstand the high applied voltage, and in the other by connecting one of the outer electrodes to a stream of cooling water. [See also Abstract 1993 (1925).] R. S. R.

2478. *Inhibition of the Glow of Phosphorus.* **H. J. Emeléus.** (Chem. Soc., J. pp. 1336–1344, June, 1926.)—The influence of addition of gases such as hydrogen, nitrogen, or carbon dioxide on the slow luminous oxidation of phosphorus is due only to dilution, the kinetics of the reaction continuing to obey the law of mass action. In other cases, a small concentration of the added substance stops the reaction and the accompanying phenomena of ionisation and formation of ozone. In pure oxygen the reaction is imperceptible at atmospheric pressure, but if the pressure is lowered to a certain value the phosphorus surface suddenly lights up and normal oxidation commences. This inhibition of the oxidation by oxidation itself finds a parallel in the action of stronger poisons such as ethylene, addition to air of such typical inhibitors rendering it easier to blow the glow from a phosphorus surface; this action is diminished as the temperature rises. Rayleigh's tentative explanation of the mechanism of such effect is discussed. T. H. P.

2479. *Action of Phosphorus on Salts of Silver and Other Metals.* **O. J. Walker.** (Chem. Soc., J. pp. 1370–1381, June, 1926.)—The precipitation of many heavy metals from solutions of their salts by phosphorus was investigated. It appeared that the most suitable salts for detailed investigation were those of silver and copper. The results of the experiments showed that when a stick of phosphorus was placed in a solution of the metallic salt, a reaction proceeds in two distinct stages. The first is the formation of a black phosphide on the surface of the phosphorus, and the solution is found to contain phosphorus acid. After the formation of the phosphide the metal begins to be deposited in a bright crystalline state, and phosphorus is oxidised to phosphorus and phosphoric acids. Four equivalents of the metal were deposited for every atom of phosphorus oxidised. The formation of phosphide is explained by the prior formation of phosphine by the action of phosphorus on water. Evidence was obtained to show that only those metallic salt solutions of the heavy metals which react with phosphine and form phosphides are able to react with phosphorus. The mechanism of the reaction was explained by assuming the existence of pentavalent phosphorous ions. F. J. B.

2480. *Affinity of Bromine Atoms for Electrons.* **G. Piccardi.** (Accad. Lincei, Atti, 3. pp. 566–568, May 2, 1926.)—The method described in a previous paper [Abstract 2223 (1926)] for the determination of the affinity of iodine atoms for electrons is complicated in the case of bromine by the fact that the dissociation of bromine molecules may not be complete in the flame, and that hydrobromic acid may be formed from the hydrogen of the flame. Calculation of the effect of these phenomena is made as far as is possible, and the same experimental arrangements are used. The bromine is introduced into the flame as ethyl bromide. From three determinations a value of 86,700 cals. is deduced which compares with that calculated after Born, 87,000 cals. A. Wh.

2481. *Mechanism of the Photochemical Reaction between Hydrogen and Chlorine. Part III. The Mean Life of Activity in Illuminated Chlorine.* **A. L. Marshall.** (J. Phys. Chem. 30. pp. 757–762, June, 1926.)—A detailed description is given of elaborate precautions taken to ensure purity of chlorine and generally improved technique in repeating the experiments of Bodenstein and Taylor on the mean life of reactivity in illuminated chlorine. No reactivity is detected when pure chlorine is passed into hydrogen 3×10^{-4} sec. after intense illumination by a quartz mercury arc, even when special arrangements are made to moisten the chlorine with pure water before exposure. This result being directly contrary to a mathematical analysis based on the Nernst atomic mechanism, which predicts a large reaction, the alternative possibilites are suggested that either this mechanism is incorrect and it is necessary to assume a mechanism involving excited chlorine molecules, or the walls of the capillary employed remove the chlorine atoms by causing their recombination. A. B. C. L.

2482. *Precipitation of Mastic Suspensoids.* **H. V. Tartar** and **C. Z. Draves.** (J. Phys. Chem. 30. pp. 763–776, June, 1926.)—Experiments are undertaken to determine the effect of varying dispersity, of concentration and of variety of mastic on the concentration of KCl required for precipitation of mastic suspensions at varying H-ion concentrations. The data show a reciprocal relation between pH and log 1/(KCl). Mastic suspensoids prepared from different varieties of gum mastic and differing widely in concentration and dispersity are found to possess different H-ion concentrations and to require different concentrations of KCl for coagulation. The acidity of mastic suspensoids is due principally to organic acid in true solution, and decreases with dilution. There is no great liberation of H-ions or OH-ions during coagulations with KCl. For a given variety of mastic all suspensoids precipitate at about the same pH with HCl alone regardless of concentration or dispersity. In the pH range beyond 6·0 they all precipitate with nearly the same KCl concentration. The minimum concentration of KCl for coagulation of a mastic suspensoid is dependent entirely upon the pH of the dispersion medium. When coagulations are conducted at different pH values by varying the acidity of the precipitant, the curve relating pH to log 1/(KCl) for minimum coagulation concentrations is shown for one variety of mastic to be the same for suspensions of different concentration and dispersity. This curve is found to be a straight line in the pH range from 2·4 to 5·0. The curves for the suspensoids prepared from two varieties of mastic are not coincident, but are nearly parallel. A. B. C. L.

2483. *Origin of the E.M.F. of a Photoelectric Cell containing a Fluorescent Electrolyte.* **A. Grumbach.** (Phil. Mag. 2. p. 313, July, 1926.)—The author disagrees with some of the conclusions drawn by

W. Rule from his measurements of this effect [see Abstract 1711 (1926)]. He explains the inflections in the curve connecting e.m.f. and time for various concentrations by considering the e.m.f. made up of two parts varying in different ways with the time of illumination, and considers that the Becquerel-effect, produced in solutions of high fluorescein concentration, has been neglected. By working in the dark the effects can be separated. It is also stated that mistakes in the measurement of the conductivity of fluorescent electrolytes are to be found not only in the Becquerel-effect if an electrode is illuminated, but also in the e.m.f. produced by the illumination of the liquid mass which arises if the apparatus is not disposed in a strictly symmetrical manner in the light pencil.
R. S. R.

2484. *Polarisation Capacity of Platinised Platinum Electrodes in Aqueous Mixtures of Ferro- and Ferri-potassium Cyanides.* **K. Becker.** (Zeits. Elektrochem. 32. pp. 305–311, June, 1926.)—When the polarisation capacity C is regarded as a condenser charge, the C should be constant and independent of the frequency n of the charging current (Gordon), or change with the frequency so that $C\sqrt{n} = \text{const.}$ (M. Wien). Which relation will be true will depend according to Warburg on the salt concentration; there is diffusion of the salt and fixation of it by the electrode, subject to surface-tension. F. Krüger [Abstract 3138 (1904)] modified this condition on the Helmholtz-Nernst theory by adding that, in the case C = constant, the mass of salt freely diffusing to the electrode surface was equal to the mass electrically transported diminished by the salt bound in the charge reversal of the double layer. The author develops in his dissertation (the paper is an abridgment) Krüger's formulæ, and describes experiments with mixed aqueous solutions of ferro- and ferri-prussiates. The ratio of the two salts is either kept constant or varied in the determination of the influence of the frequency n on C. With increasing n (up to 150,000), C became constant and independent of n; but at very high frequency the capacity rose slightly, possibly because the periods were too short and surface irregularities had more influence. The rule C = constant held for small total salt concentration; with more concentrated mixtures the rule $C\sqrt{n}$ was found to apply. The electrode was the less polarisable the more the rate ferro/ferri salt approached unit value.
H. B.

2485. *Polarisation Capacity over a Wide Frequency Band.* **I. Wolff.** (Phys. Rev. 27. pp. 755–763, June, 1926.)—The polarisation capacity of platinum electrodes in sulphuric acid and also of gold electrodes in sulphuric acid has been studied from 200 to 200,000 cycles per second. An alternating-current bridge was used to make the measurements in the audible range and a bridge with heterodyne detector for the higher frequencies. If the relation connecting capacity and frequency is put in the form $C = C_0/f^P$, where C_0 and P are constants, then at the lower frequencies P is nearly equal to 0·3, while at the higher frequencies it approaches 0·5. At the same time, the phase angle of the capacity shifts from about 20 to about 40 degrees. Voltage measurements made to determine the limiting value of the initial capacity show that it is of the same order of magnitude for alternating current as for direct charge. When two harmonic alternating currents of differing frequencies are simultaneously impressed on a cell, the polarisation capacity measured by means of either one is independent of the presence of the other. AUTHOR.

2486. *Significance of the Physico-Chemical Analysis of Colloids from the Standpoint of the Theory of Electrolytes.* **W. Pauli and E. Valkó.** (Zeits. phys. Chem. 121. pp. 161–179, June 10, 1926.)—Investigation of the capacity for reaction of the ionogenic molecules of various colloidal substances by the method of conductometric precipitation and titration gives results in accord with those obtained by experiments on substitution by flocculation and indicates that all ionogenic molecules are in a condition accessible to reaction. The diminished activity of such molecules as regards current transport and the e.m.f. of concentration cells cannot, therefore, be explained by the assumption that the molecules are enclosed in micelles. T. H. P.

2487. *Activity Coefficients of Hydrochloric Acid in Non-aqueous Solutions.* **W. W. Lucasse.** (Zeits. phys. Chem. 121. pp. 254–266, June 10, 1926.)—Measurements of e.m.f. are made with the chain $H_2/HCl/AgCl/Ag$ with concentrations of acid varying from 0·001 to 4 N and with water and water-glycerine mixtures as solvents. Data from measurements by other workers with ethyl and methyl alcohol and mixtures of these alcohols with water are also utilised. The validity of the formula derived by Hückel is investigated, according to which

$$\log \gamma = -\frac{A\sqrt{2c}}{1 + \alpha\sqrt{2c}} + B2c - \log(1 + 0{\cdot}002\, mM_0),$$

where γ is the activity coefficient of the electrolyte, m its molecular concentration in unit weight of the solvent, and c its molecular concentration in unit volume of solution. M_0 is the mean molecular weight of the solvent and A, α and β are constants. A is given by the equation

$$A = \frac{4343\epsilon^2}{2D_0kT}\sqrt{\frac{4\pi\epsilon^2N}{D_0kT1000}},$$

where ϵ is the elementary charge $(4{\cdot}77 \times 10^{-10})$, k the Boltzmann constant $(1{\cdot}371 \times 10^{-16})$, N the Avogadro number $(6{\cdot}06 \times 10^{-23})$, T the absolute temperature, and D_0 the dielectric constant of the solvent. The constant α is determined by the mean diameter of the ions, and β by the dielectric constant of the solution. The values of the activity coefficients thus calculated are compared with those determined by e.m.f. measurements from the relation

$$\Delta E = 0{\cdot}1163 \log \frac{\gamma_1 m_1}{\gamma_2 m_2},$$

where γ_1, γ_2 denote the respective coefficients at the concentrations m_1 and m_2. A satisfactory agreement is found between calculated and measures values. [See Abstract 1168 (1926).] J. N. P.

2488. *Potential of Fluorine.* **B. Neumann.** (Zeits. Elektrochem. 32. pp. 274–276, June, 1926.)—The determination of the potential of fluorine from the decomposition potential of molten fluorides by Neumann and

Richter [see Abstract 205 (1926)] was criticised by O. Ruff and W. Busch. In the present communication these criticisms are replied to and discussed.
F. J. B.

2489. *Controlling Factors of Transfer Resistance.* **E. Newbery.** (Roy. Soc., Proc. 111. pp. 182–189, May 1, 1926.)—The variations of transfer resistance due to condition of electrode surfaces and changes of current density with copper, silver, gold, nickel and platinum [see Abstract 1776 (1925)] show that such resistance is almost independent of the chemical nature of the electrode, but is high with polished surfaces and low current densities and low for rough surfaces with high current densities. When the current density becomes very high, transfer resistance is very low and almost independent of the nature and condition of the electrode surface, but is greatly affected by changes in the concentration of the electrolyte. Transfer resistance is composed of two parts: (1) the resistance of a film of gas over the electrode surface, and (2) the resistance of a layer of partially exhausted electrolyte surrounding the electrode. The fall of transfer resistance at high current densities is due to increase in the conductivity of the gas film under the influence of a high potential gradient. Overvoltage is essentially a chemical and transfer resistance a physical phenomenon.
T. H. P.

2490. *Evidence for a Film Theory of Hydrogen Overpotential from Surface-tension Measurements.* **A. L. McAulay** and **F. P. Bowden.** (Roy. Soc., Proc. 111. pp. 190–200, May 1, 1926.)—Simultaneous measurements of the single electrode potential at a mercury kathode and of the changes in surface-tension of the mercury when various currents flow through different electrolytes show that a film of high surface-tension must be formed over the mercury before hydrogen can be liberated at the kathode. In a pure acid electrolyte the passage of extremely small quantities of electricity produce this film, which remains intact when the circuit passing the current is broken. The addition to the acid of small quantities of ions of metals more noble than copper destroys the film completely and instantly, whereas that of ions of metals less noble than copper leaves the film intact; the effect of copper is intermediate to these two effects. Thus it seems that the film, when fully formed, has a definite place in the electrochemical series. The production of an overpotential at the kathode requires the initial establishment of the film. Conditions that will not produce overpotential when a film has not first been formed over the kathode do produce an overpotential when a film has been previously formed. The film may be built up slowly by the passage of extremely small currents. Until a certain stage is reached the single electrode potential measured above the reversible potential of mercury is proportional to the surface-tension of the film. Further addition to the film increases the single electrode potential, but leaves the surface-tension approximately constant.
T. H. P.

2491. *Experiments on Hydrogen Overpotential at a Mercury Kathode and their Bearing on Current Theories.* **A. L. McAulay** and **F. P. Bowden.** (Phil. Mag. 1. pp. 1282–1285, June, 1926.)—Overvoltage at a mercury kathode with a mixed electrolyte containing acid and metallic salt is found to be independent of the total current flowing [see preceding Abstract], remaining constant over large ranges of total current if the current carried by the hydrogen ions is the same in each case. When overvoltage is established, both metal and hydrogen are deposited at a high potential characteristic of hydrogen, no matter what the value of the reversible potential of the metal. Four different theories which have been advanced to explain overpotential are discussed in the light of these and other results. The evidence is strongly against the theory according to which overpotential is the result of an ohmic resistance, and also against that which supposes it to be due to a high concentration produced by the slowness of a stage in the transformation of hydrogen ions into gaseous hydrogen. It is suggested that a combination of the theory of an active film of hydrogen or hydride, the high free energy of which provides part of the overpotential, with the view that a further overpotential is necessary for the desorption of this film, might explain all the known facts. T. H. P.

2492. *Electrode Capacity and Resistance of Electrolytes.* **B. B. Banerji.** (Faraday Soc., Trans. 22. pp. 111–132; Disc., 132–133, May, 1926.)—The variation of polarisation capacities and resistances with frequency was determined for a number of electrolytes for a wide range of frequencies. The law of variation suggested by Haworth and a law similar to that suggested by Warburg have been shown to hold only through a small range of frequency. A law is given which holds for the variation of polarisation capacity throughout the range investigated. The hypothesis of double leaky capacities at the electrodes was put forward to explain this law. The hypothesis was shown to be satisfactory. The existence of the capacities was shown to be probably due to the double layer and to the concentration changes brought about by transport phenomena. The thickness of the double layer calculated from the value of the double-layer capacity was shown to be of the correct order and to be consistent with the value obtained by other methods. F. J. B.

2493. *Theory of the Electrolytic Formation of Ammonium Persulphate.* **O. A. Essin.** (Zeits. Elektrochem. 32. pp. 267–269, June, 1926.)—The various factors which affect the formation of ammonium persulphate were examined experimentally. It was found that the current yield did not depend on the current density, which was varied in the experiments from 1 to 2 amps. per sq. cm. up to 16 amps. per sq. cm. The current yield was found to be independent of the temperature within the range of 10° to 30° C., so long as the solution was maintained saturated with sulphate. The current yield for the temperature range of 10° to 30° C. can be calculated from the equation: $A = \frac{C_1}{C_1 + C_2} . 100\ \%$, so long as saturated solutions of sulphate are maintained. F. J. B.

2494. *Periodic Phenomena at Anodes of Copper and Silver.* **E. S. Hedges.** (Chem. Soc., J. pp. 1533–1546, June, 1926.)—Periodic changes in current strength and in the p.d. between the electrodes are observed in the anodic dissolution of copper in solutions of hydrochloric acid, ammonium chloride, sodium chloride, cupric chloride, and potassium cyanide, and of silver in solutions of potassium cyanide, sulphuric acid, and ammoniacal ammonium sulphate and ammonium chloride. In every case periodic film formation over the anode occurs. Detailed measurements with copper in hydrochloric acid show that the phenomenon takes place between certain limiting values of current density, and the critical current density required to produce the periods is a linear function of the concentration of the electrolyte. The frequency of the periods increases with rising temperature and concentration, and decreases with rising current density. The periods are not affected by catalytic poisons. At the critical current density an oxidic film forms over the metal. This film is unstable and changes to a stable state of relatively low resistance, the change being indicated by the change in colour and surface of the film. This is immediately followed by reaction with the chlorine ions, which have been accumulating through diffusion, to form cuprous chloride. The film is shown to be stable above a certain value of the current density; its metastability between this value and the critical current density is believed to be the cause of the periodicity. This case appears to be typical of all the others investigated. J. N. P.

2495. *Influence of Gelatine on the Potential of Deposition of Zinc.* **E. Rabald.** (Zeits. Elektrochem. 32. pp. 289–294, June, 1926.)—Experiments were made on the effects of different amounts of gelatine on the deposition of zinc from solutions of zinc sulphate. The results showed that the observation of Isgarischew and Titow of the maximum of polarisation on a zinc electrode in a zinc sulphate solution was with a gelatine content of 0·025 % could not be reproduced. A maximum was found at 0·005 %. The results do not definitely decide as to the existence of zinc-gelatine complexes. The polarisation is materially altered by difference of structure, metastability, and the thickness of the diffusion layer. F. J. B.

2496. *Kathodic Deposition of Metals. III. Electrochemical and X-Ray Investigations on Lead Precipitates.* **P. K. Frölich, G. L. Clark** and **R. A. Aborn.** (Zeits. Elektrochem. 32. pp. 295–305, June, 1926. From the English.)—Deposits of lead from acetate, nitrate, perchlorate, borofluoride and silicofluoride solutions in presence or absence of free acid and of gelatine have been investigated from the standpoint of the potential and of the crystalline structure indicated by X-ray analysis [see Abstracts 906, 907 (1926)]. From the practical point of view the deposit obtained from perchlorate solution in presence of excess of acid and of gelatine is the best, the kathodic polarisation being a maximum and the grain size a minimum, while dendritic growths are lacking and the orientation of the crystalline grain for any given current density most favourable. These results support present-day views on the influences of the different variables on the structure of electrolytic metal deposits, with the exception that with lead the fibrous structure is favoured by increasing current density, although, as with iron, nickel, etc., the size of the grain diminishes. The grains increase in size as the thickness of the deposit increases, and the fibrous structure is less marked in the outer layers. Experiments with iron and platinum kathodes, with and without a coating of wax, indicate that the influence of the ground metal is similar to that observed with deposits of nickel on aluminium and platinum. With lead, resistance to kathodic crystal formation is small. As regards gelatine, its influence consists in a diminution of the crystal growth and in a prevention of the regular distribution of the metal over the whole front of the electrode. T. H. P.